United States Department of Agriculture

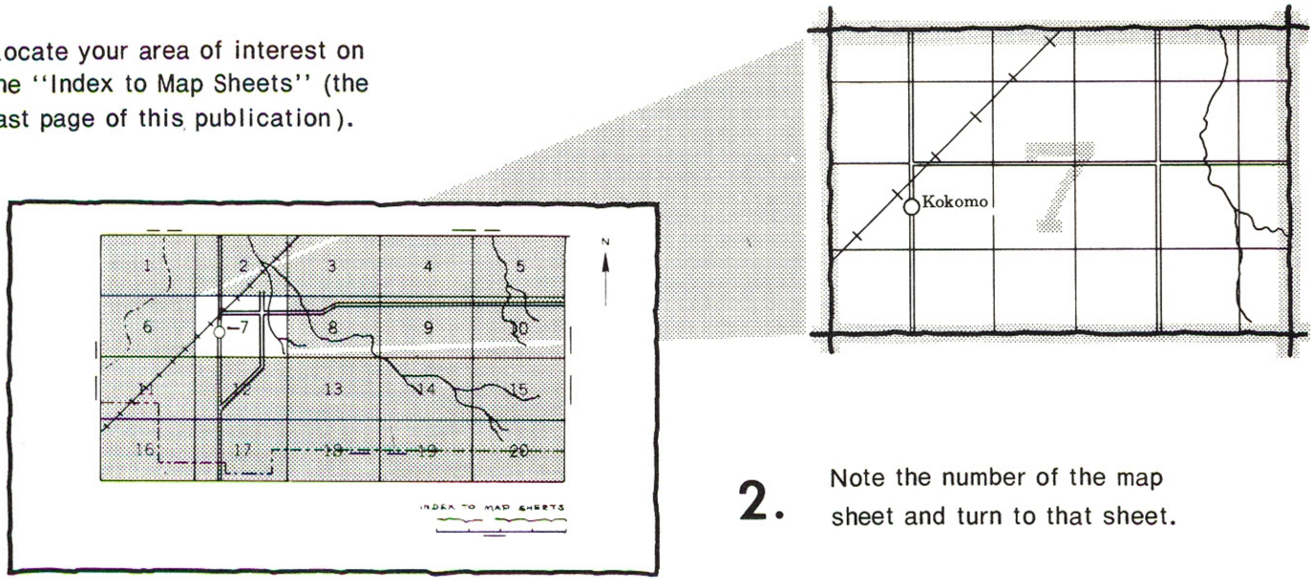
Soil Conservation Service

In Cooperation with Ohio Department of Natural Resources Division of Lands and Soil and Ohio Agricultural Research and Development Center

Soil Survey of Ottawa County Ohio

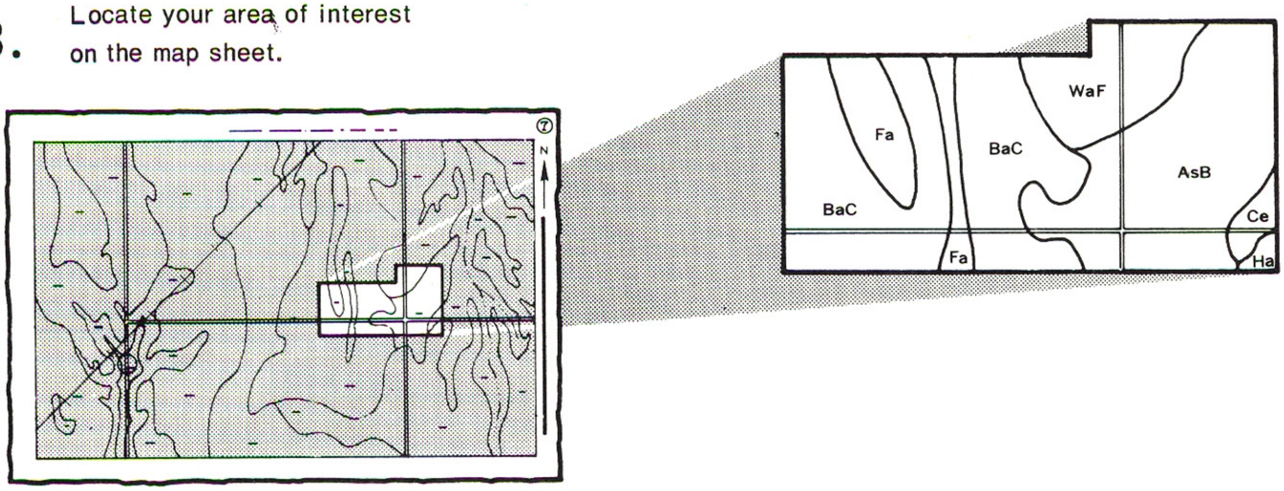
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

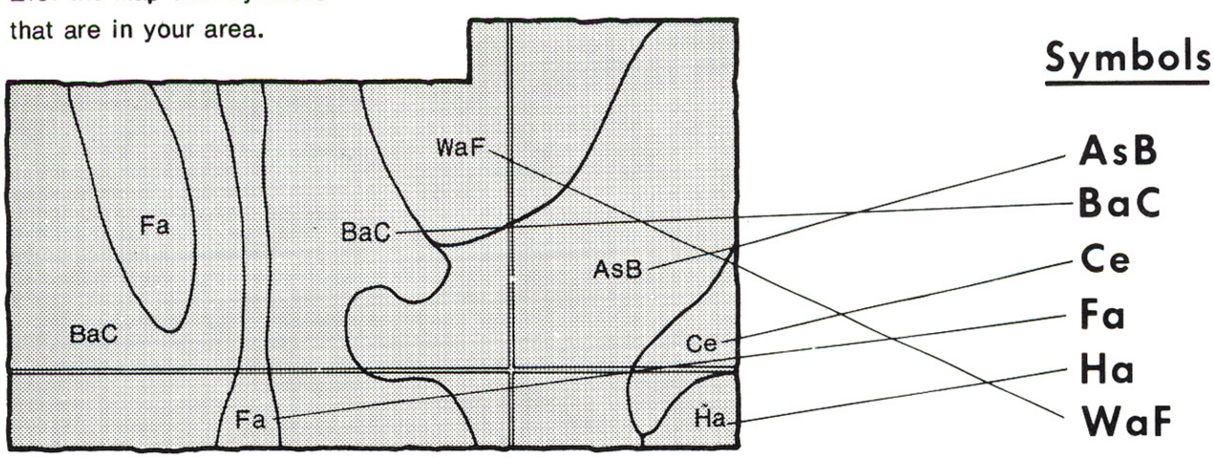


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

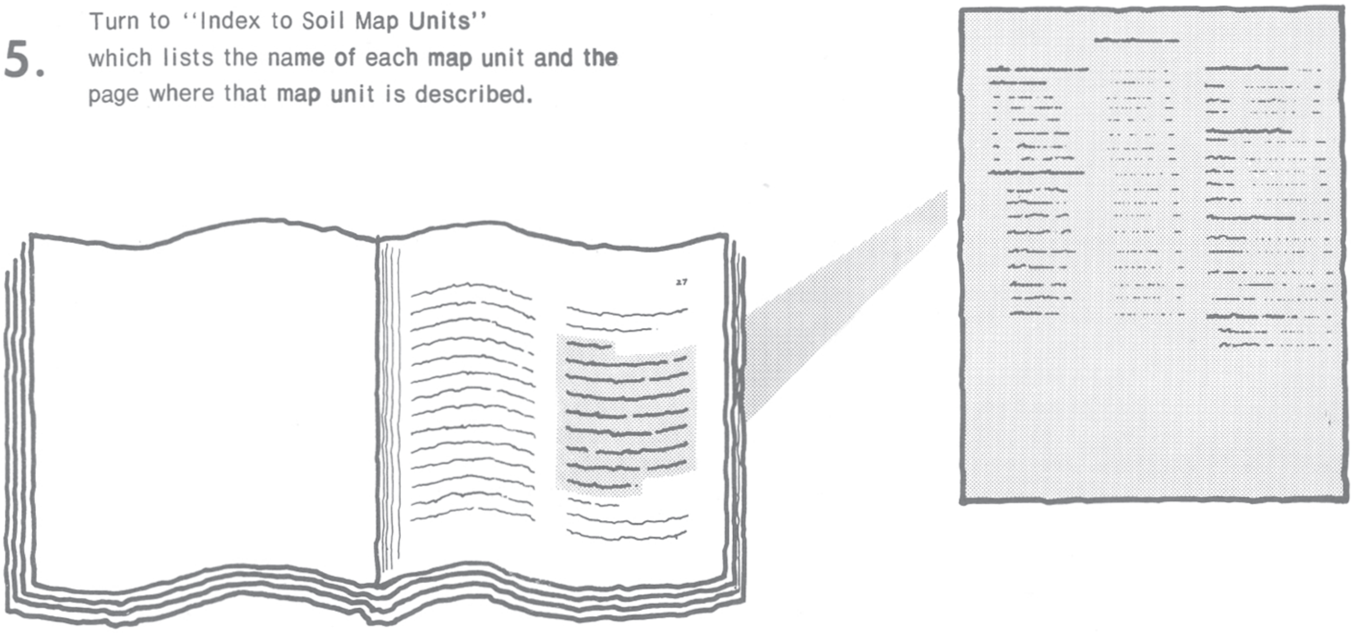


4. List the map unit symbols that are in your area.

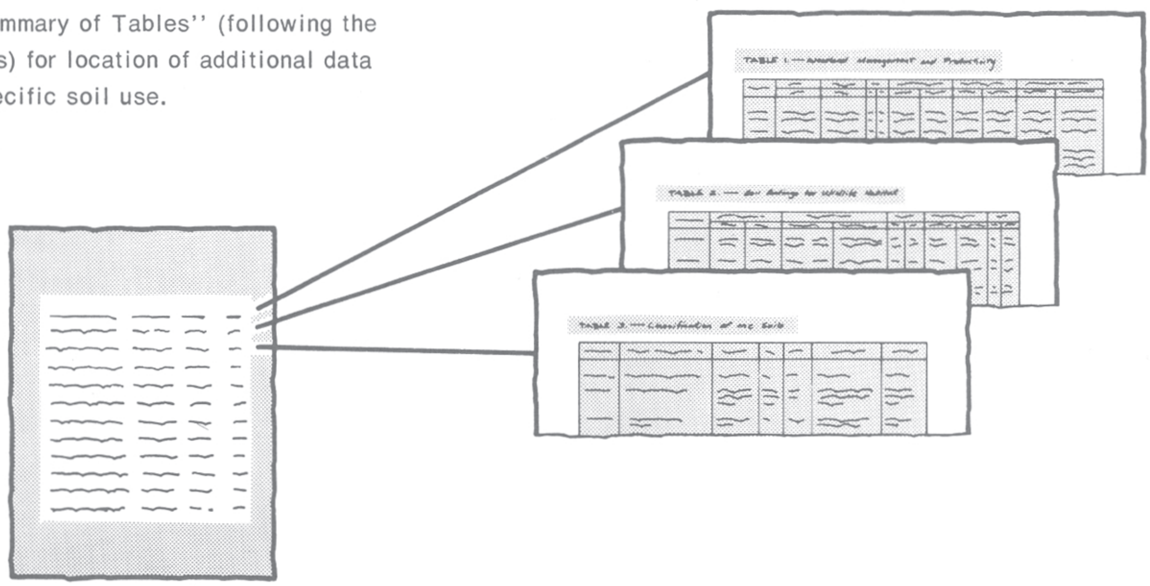


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the Ohio Department of Natural Resources, Division of Lands and Soil; and the Ohio Agricultural Research and Development Center. It was materially aided by funds provided by the Ottawa County Commissioners. The survey is part of the technical assistance furnished to the Ottawa Soil and Water Conservation District. Major fieldwork for this soil survey was performed in the period 1977-1980. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Windbreaks protect buildings from wind and snow and reduce soil blowing. This windbreak is on Nappanee silty clay loam, 0 to 3 percent slopes.

contents

soil series

Issued April 1985

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foreword

This soil survey contains information that can be used in land-planning programs in Ottawa County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A water table near the surface makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Robert R. Shaw

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Location of Ottawa County in Ohio.

soil survey of
Ottawa County, Ohio

By D. K. Musgrave and G. D. Derringer, Ohio Department of Natural Resources
Division of Lands and Soil

Fieldwork by D. K. Musgrave, R. A. Robbins, and G. D. Derringer,
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United States Department of Agriculture, Soil Conservation Service
In cooperation with Ohio Department of Natural Resources, Division of Lands and Soil, and Ohio Agricultural Research and Development Center

Ottawa County is in the north-central part of Ohio. It is bordered by Lake Erie on the east and northeast, by Sandusky County on the south, by Wood County on the west, and by Lucas County on the north. Ottawa County occupies approximately 172,160 acres, or 270 square miles. It has twelve townships.

The population of the county in 1970 was 37,099 (*17*). Port Clinton, the county seat and the largest city, is in the eastern part of the county. It had a population of 7,202 in 1970. Villages are Clay Center, Elmore, Genoa, Lakeside, Marblehead, Oak Harbor, Put-In-Bay (on the South Bass Island), and Rocky Ridge.

This survey updates the soil survey of Ottawa County published in 1928 (*11*). It provides additional information and larger maps that show the soils in greater detail.

general nature of the county

This section provides general information about the county. It discusses the climate; settlement; farming; physiography, relief, and drainage; and history and economic development of the area.

The most valuable natural resources are soil and water. Limestone and sand and gravel are other important natural resources.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Ottawa County is cold in winter and warm and occasionally hot in summer. Precipitation is well distributed throughout the year with a moderate peak in summer, and it is adequate for most crops on most soils. Winter precipitation is mainly snow, which occurs sometimes as a blizzard.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Ottawa, Ohio, in the period 1972 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 26 degrees F, and the average daily minimum temperature is 17 degrees. The lowest temperature on record, which occurred at Ottawa on January l7, l977, is -15 degrees. In summer the average temperature is 71 degrees,and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred on July l5, l977, is 100 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 34 inches. Of this, 20 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 14 inches. The heaviest 1-day rainfall during the period of record was 3.28 inches at Ottawa on June 26, 1978. Thunderstorms occur on about 40 days each year, and most occur in summer.

Average seasonal snowfall is 26 inches. The greatest snow depth at any one time during the period of record was 13 inches. On an average of 35 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 65 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in spring.

settlement

Ottawa County was formed March 6, 1840 and acquired its name from a tribe of Indians whose last home in Ohio was near the Maumee River. The name "Ottawa" signifies trader and applied to this tribe because of their commercial transactions with the early white settlers. Their principal stock in trade was furs. The county was formed from Sandusky, Erie, and Lucas Counties. The General Assembly of the State of Ohio established the town of Port Clinton as the county seat on March 12, 1840 (*5*).

A most notable event in the history of the county was the capture of the British fleet by Commodore Oliver H. Perry at the Battle of Lake Erie in 1813. Occurring near the Ottawa County islands, this victory opened the way for settlement of the county.

The first settlements were made by the French, but they made very little progress for years in clearing the land because their principal occupations were hunting, trapping, and trading with the Indians. The people of mixed French and Indian descent who came to Catawba Island as early as 1795 subsisted chiefly on hunting and trapping (*6*). Many other early settlers came to the county in the early nineteenth century from Connecticut. Since they were impressed with the climate and soil, they established farms. Some of the eastern part of the county is within the area known as the "Fire Lands" and was donated by the state of Connecticut to persons whose property was destroyed by fire.

Malaria and other ague-type diseases were common during settlement and constituted a great obstacle to early settlers, especially in the Black Swamp. This problem abated as forests gave way to cultivated fields and the swamps and marshlands were drained.

Blackbirds were also a problem for early settlers. Especially near swamps, they drove into grain fields by the thousands and totally destroyed unguarded crops.

Originally most of the county was heavy timber. It disappeared as the population expanded, and the lumbering business was developed. This was later followed by farming. Corn was the leading grain crop, and wheat, oats, barley, and rye were also produced. Other vocations contributing to early settlements included stock raising, fruit growing, and wine making. Many German settlers found the county islands ideal for grape growing and wine making. Other settlements developed around the kiln processing and shipping of some of the finest quality limestone of that day.

A few years after the first permanent settlements were made, hundreds of barrels of fish were caught and shipped annually. The fish population decreased fivefold by 1874 due to the great number of people in the fishing industry, improved fishing equipment, and increased demand.

farming

In 1979, about 72 percent of the land area in Ottawa County was farmed (*16*). The major commodities, ranked according to the percentage of total cash receipts in the county, were soybeans, 46 percent; wheat, 12 percent; corn, 11 percent; vegetables and fruits, 11 percent; cattle and calves, 4 percent; hogs, 3 percent; dairy products, 3 percent; poultry, 2 percent; and all others, 8 percent (*15*).

According to the Census of Agriculture, the average size of farms increased from 133 acres in 1969 to 144 acres in 1974. The number of farms decreased during this period from 979 to 785 (*18*).

In 1979 the acreage in soybeans grown for all purposes was 57,100 acres and in corn was 15,400 acres. The acreage in fruits and vegetables remained at about 4,000 acres. The acreage in hay was 8,600 acres. The number of hogs and pigs was 4,400, and the number of cattle and calves was 5,100.

physiography, relief, and drainage

Ottawa County soils are post-glacial in origin, and most of the county is in the lake plain of glacial Lake Maumee. Glacial lake sediments in which the soils formed are variable in thickness. Several outcrops of limestone in the county are primarily in the western part, the peninsula, and the islands. Other distinct features of the landscape are the marshland and bogs around Lake Erie and Sandusky Bay.

Ottawa County lies entirely within the glaciated part of Ohio. The lake plain sediments covering most of the county are underlain by glacial till, which is further underlain by limestone.

The county drains mainly into Lake Erie through the Portage and Toussaint Rivers and Crane, LaCarpe, and

Turtle Creeks and their tributaries. The southeastern part of the county drains through Muddy Creek and its tributaries into Sandusky Bay.

The surface relief of the county is nearly level to sloping. West of Port Clinton the surface is flat and is but little elevated above Lake Erie. Shallow stream valleys cut to a depth ranging from 15 to 25 feet. The low limestone ridges, or knolls, rise 5 to 15 feet above the general level to break the evenness of the landscape. East of Port Clinton the relief is undulating or gently rolling. It is generally level along the lake front and rises gently inland, except in Catawba Island Township and at the eastern end of Marblehead Peninsula where limestone bedrock protrudes above the surrounding plain.

Water supplies of the municipal areas come from Lake Erie. Rural areas obtain water from subsurface aquifers.

history and economic development

The battle of Lake Erie, in which Commodore Perry defeated the British fleet in September 1813, opened the way for the defeat of the united British and Indian forces in the Northwest Territories. Finally, American commerce on the lake was made safe (*7*).

The first vocations in Ottawa County were concerned with the quest for food and included fishing, hunting, and trapping. Even today, commercial fishing and trapping contribute much to the economic welfare of the county. In early stages of settlement, forests were cut down and a lumber industry was developed. After the forests were cleared, the land was used for cultivated crops.

The early agricultural industry consisted of grain farming and stock raising as well as fruit and vegetable growing. Increases, however, in tillable agricultural land were slow in coming. With much of the county in level, impermeable soils, artificial drainage was necessary to make tillage possible.

Vineyards and wineries flourished in some areas, especially on Middle and North Bass Islands. The growing of grapes began in 1850, in the area east of Port Clinton, and continued until infestations of black rot became severe. Because the soil and climate in this area are particularly suitable for orchards, vineyards gave way to peach orchards in about 1885. Peaches were the leading fruit crop until the late 1920's. Early in the twentieth century, general farming became prevalent in the central and western parts of the county. Wheat was a leading cash crop, and sugar beets were an important special crop in this period. About this time, poultry production began to increase, and muskrat farming was a new venture in the county.

The population of Ottawa County grew from 2,248 in 1840 to 37,099 in 1970 (*3*). This increase in population resulted from four major factors. First, the county's location between the major urban centers of Cleveland and Toledo made it a convenient recreation area for city dwellers and a good residential area from which to commute to jobs in urban centers. Second, Camp Perry was established in 1906 as an Ohio National Guard training ground. A number of full-time employees were also needed to run and maintain Camp Perry. Third, the Erie Army Depot was established adjacent to Camp Perry in 1918 to overhaul, repair, supply, and test military equipment. When it was phased out in the 1960's, hundreds of jobs were lost. Fourth, several private manufacturing industries also located in the county, creating several hundreds of jobs (*10*).

The primary manufacturing industries include stone, clay, and rubber products as well as food processing. The stone-clay industry involves the making of concrete, sandstone, lime, and gypsum products. Food industries in the county include processing plants for meat, animal food, fruit and vegetables, and fish; dairies; wineries; and candy factories. Near the lake, the storage, repair, and servicing of boats are thriving industries.

Recreation is seasonally important in the region's economy. The county has many summer cottages, trailer camps, motel areas, small amusement parks, golf courses, and boat marinas. Various types of boats, including sailboats, cabin cruisers, and yachts, are operated from the marinas along Lake Erie. The national pistol and rifle matches are held at Camp Perry and draw contestants from every state in the Union. More than 40,000 visitors can be expected to attend certain special events.

Today major highways connect centers of trade throughout the county. Major railroads provide transportation from Cleveland and Fremont to Toledo. Air transportation is available from the Bass Islands to the mainland, and there is an auto ferry. The Sandusky Bay Bridge, which was built in 1929, shortened highway travel from Ottawa County east to Sandusky and Cleveland by 20 miles. The present Sandusky Bay Bridge was built in the 1960's and provides for a greater flow of traffic.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas, called soil associations, that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

soil associations

1. Castalia-Milton association

Moderately deep, nearly level and gently sloping, well drained soils formed in dominantly loamy and clayey material over dolomitic limestone bedrock

This association occurs on slight rises and knolls on the lake plains and on islands. It is underlain by limestone bedrock.

This association covers about 6 percent of the county. It is about 45 percent Castalia soils, 15 percent Milton soils, and 40 percent soils of minor extent.

Castalia and Milton soils are on the tops and sides of rises and knolls. Castalia soils are nearly level and gently sloping and well drained. They formed in residuum from fractured limestone and in glacial drift in voids in the bedrock. Permeability is rapid, and the available water capacity is very low. These soils are very stony. Milton soils are gently sloping and well drained. They formed in loamy and clayey glacial till over limestone bedrock. Permeability is moderately slow, and the available water capacity is low.

The minor soils in this association are in the Rawson, Haskins, Dunbridge, and Millsdale series. The Rawson soils are deep and moderately well drained and well drained; the Haskins soils are deep and somewhat poorly drained; the Dunbridge soils formed in glacial outwash over limestone bedrock; and the Millsdale soils are very poorly drained and are in depressions. Small quarries are in some areas.

The soils in this association are used for orchards, vineyards, and brush. Many areas are used for trailer parks and recreation. These soils are suited to these uses. The lake influences the temperatures in spring, greatly reducing frost damage. Because the Castalia soils are stony and droughty, they are generally not suited to corn, soybeans, and small grains. The Milton soils, however, are suited to these uses. Both soils are poorly suited to septic tank absorption fields. They are moderately well suited to poorly suited as a site for buildings.

Because the available water capacity of these soils is low or very low, conservation of moisture is important. These soils are suited to irrigation and to grazing early in spring. They are better suited to houses without basements than to houses with basements. Blasting of bedrock is generally needed before a basement can be constructed or underground utility lines can be installed. The effluent from sanitary facilities may move through fissures in the bedrock and contaminate underground water supplies. Central sewage systems should be used wherever possible.

2. Hoytville-Nappanee association

Deep, nearly level, very poorly drained and somewhat poorly drained soils formed in silty and clayey glacial till

This association is on broad, flat, uniform lake plains that have slight rises. The soils are mainly nearly level; however, some sloping areas are along drainageways.

This association covers about 20 percent of the county. It is about 55 percent Hoytville soils, 20 percent Nappanee soils, and 25 percent soils of minor extent.

Hoytville soils are on broad flats and along poorly defined drainageways, and Nappanee soils are on slight rises and in long, narrow, low slope breaks along drainageways. Hoytville soils are nearly level and very poorly drained. They formed in glacial till. Permeability is slow. A seasonal high water table is near or above the surface, and these soils are ponded during periods of heavy rainfall. Nappanee soils are nearly level and somewhat poorly drained. They formed in glacial till. Permeability is slow. A seasonal high water table is at a depth of 12 to 24 inches. Both soils have a moderate available water capacity.

The minor soils in this association are in the Haskins, Toledo, Millsdale, St. Clair, Wabasha, Genesee, and Shoals series. The somewhat poorly drained Haskins soils are on slight rises; the very poorly drained Toledo soils are in depressions and on flats; the very poorly drained, moderately deep Millsdale soils are near bedrock highs; the moderately well drained St. Clair soils are on side slopes along drainageways; and the very poorly drained Wabasha soils, the well drained Genesee soils, and the somewhat poorly drained Shoals soils are on flood plains.

Most areas of this association are used as cropland. Specialty crops are grown in some areas. These soils are suited to corn, soybeans, and specialty crops when drained. They are poorly suited to moderately well suited as a site for buildings and poorly suited to generally not suited to septic tank absorption fields.

Ponding, slow permeability, and high shrink-swell potential are major limitations to the use of these soils. Surface and subsurface drains are commonly used to improve drainage. These soils should be tilled, harvested, or grazed within a narrow range of moisture content, because they become compacted and cloddy if worked when wet. Because Nappanee soils are on slight rises and slope breaks along drainageways, they are better suited as sites for buildings than the Hoytville soils. Tops of foundations should be elevated above normal grade, and building sites and septic tank absorption fields should be landscaped for good surface drainage away from foundations and absorption fields.

3. Lenawee-Kibbie-Colwood association

Deep, nearly level, very poorly drained and somewhat poorly drained soils formed in silty, loamy, and sandy glacial lakebed deposits

This association is on broad flats and slight rises on lake plains. The soils are mainly nearly level; however, some sloping areas are on side slopes along drainageways.

This association covers about 10 percent of the county. It is about 25 percent Lenawee soils, 15 percent Kibbie soils, 10 percent Colwood soils, and 50 percent soils of minor extent.

All three of the major soils are on broad flats. Kibbie soils are also on slight rises, and Lenawee and Colwood soils are in depressions. Lenawee soils are very poorly drained. They formed in silty and loamy lakebed sediments. They have a seasonal high water table near or above the surface and are ponded during periods of heavy rainfall. Kibbie soils are somewhat poorly drained. They formed in stratified loamy and sandy lakebed sediments. They have a seasonal high water table at a depth of 12 to 24 inches. Colwood soils are very poorly drained. They formed in loamy and sandy lakebed sediments. They have a seasonal high water table near or above the surface and they are ponded during periods of heavy rainfall. Permeability is moderate. All three soils have a high available water capacity.

The minor soils in this association are in the Del Rey, Rimer, Nappanee, St. Clair, Genesee, Haskins, and Rawson series. The somewhat poorly drained Del Rey, Rimer, and Nappanee soils are on slight rises; the moderately well drained St. Clair soils are on slope breaks along drainageways; the well drained Genesee soils are on flood plains; and the somewhat poorly drained Haskins and the moderately well drained and well drained Rawson soils are on terraces.

The soils in this association are used mainly for crops. Some areas are used for specialty crops. Drained areas are well suited to corn, soybeans, small grains, and specialty crops. This association is poorly suited to moderately well suited as a site for buildings and moderately well suited or generally not suited to septic tank absorption fields.

Ponding is a major limitation for most uses of these soils. Soil blowing is a hazard in unvegetated areas of the Kibbie soils. Surface and subsurface drains are commonly used to improve drainage. Planting cover crops, using conservation tillage that leaves crop residue on the soil surface, and returning crop residue to the soil increase infiltration and reduce damage from soil blowing. Kibbie soils are better suited as a site for buildings and septic tank absorption fields than the Colwood and Lenawee soils. Building sites should be landscaped for good surface drainage away from foundations. Using drains at the base of footings and using exterior basement wall coatings help prevent wet basements. Sloughing is a hazard in excavations in the Colwood and Kibbie soils.

4. Toledo association

Deep, nearly level, very poorly drained soils formed in clayey glacial lakebed sediments

This association is on broad flats adjacent to a lake and bays and rivers. The soil surface is commonly lower than the water level during most of the year.

This association covers about 14 percent of the county. It is about 85 percent Toledo soils and 15 percent soils of minor extent.

Toledo soils are on broad flats. They are nearly level and very poorly drained. They formed in clayey lakebed sediments. Permeability is slow. Runoff is very slow. These soils are ponded for long periods unless they are pump drained. The available water capacity is moderate.

The minor soils in this association are in the Bono, Nappanee, and Oakville series. The Bono soils have a thicker dark-colored surface layer and are in depressions; the somewhat poorly drained Nappanee soils are on slight rises; and the well drained Oakville soils are on beach ridges.

Large areas of this association in which the water level is controlled by dikes and floodgates are used as habitat for wetland wildlife. Pump drainage is used in some areas that are farmed. These soils are generally not suited to crops unless they are artificially drained. They are also generally not suited to woodland and as a site for buildings and septic tank absorption fields. They are well suited to habitat for wetland wildlife.

Levees, open ditches, subsurface and surface drains, and pump drainage are commonly used in areas that are farmed. Pump drainage permits the growing of grain crops and the flooding of these areas to attract and feed wetland waterfowl during migration.

5. Toledo-Nappanee association

Deep, nearly level, very poorly drained and somewhat poorly drained soils formed in clayey glacial lakebed sediments and glacial till

This association is on broad, flat lake plains that have slight rises. The soils are mainly nearly level; however, some sloping areas are along waterways.

This association covers about 50 percent of the county. It is about 55 percent Toledo soils, 20 percent Nappanee soils, and 25 percent soils of minor extent (fig. 1).

Toledo soils are on broad flats and in long, narrow depressions. Nappanee soils are on slight rises and on slope breaks along drainageways. Toledo soils are nearly level and very poorly drained. They formed in clayey lakebed sediments. Permeability of the Toledo soils is slow. These soils have a seasonal high water table near or above the surface and are ponded during periods of heavy rain. Nappanee soils are nearly level and somewhat poorly drained. They formed in silty and clayey glacial till. Permeability of the Nappanee soils is slow. A seasonal high water table is at a depth of 12 to 24 inches. Both soils have a moderate available water capacity.

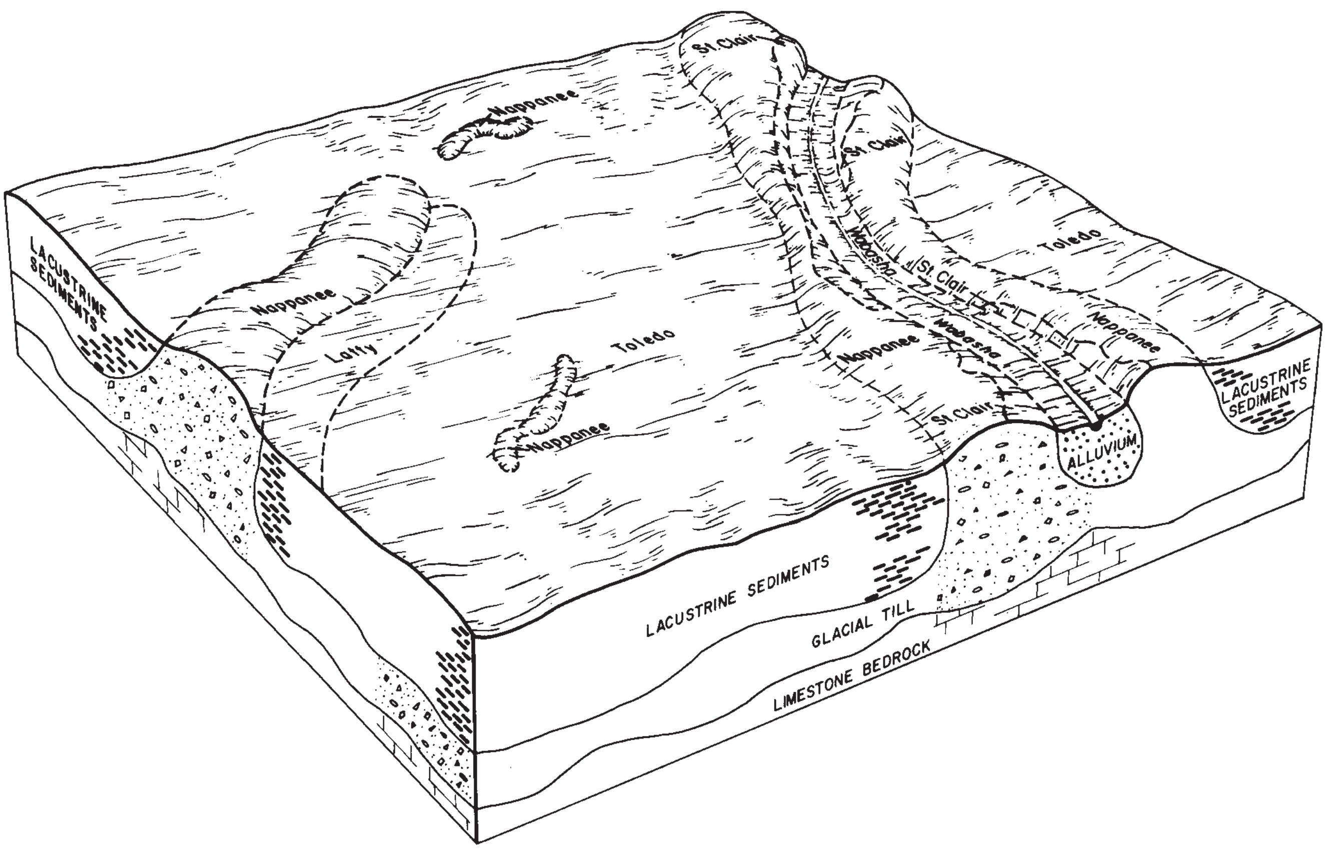

Figure 1.—Typical pattern of soils and underlying material in the Toledo-Nappanee association.

The minor soils in this association are in the Bono, Hoytville, Latty, Lenawee, Haskins, Rimer, St. Clair, Wabasha, Genesee, and Shoals series. The very poorly drained Bono, Hoytville, Latty, and Lenawee soils are on flats and in depressions; the somewhat poorly drained Haskins and Rimer soils are on slight rises; the moderately well drained St. Clair soils are on side slopes along drainageways; the very poorly drained Wabasha soils are on narrow flood plains; and the well drained Genesee and somewhat poorly drained Shoals soils are on the wider flood plains.

The soils in this association are used mainly for corn and soybeans. Some areas are used for specialty crops. Drained areas are suited to row crops, small grains, and specialty crops. These soils are moderately well suited to poorly suited as building sites. They are poorly suited to generally not suited to septic tank absorption fields.

Ponding, slow permeability, and high shrink-swell potential are major limitations to the use of these soils. Surface and subsurface drains are commonly used to improve drainage. These soils should be tilled, harvested, or grazed within a narrow range of moisture content, because they become compacted and cloddy if worked when wet. Because Nappanee soils are on slight rises and slope breaks along drainageways, they are better suited as sites for buildings than Toledo soils. Tops of foundations should be elevated above normal grade, and building sites and septic tank absorption fields should be landscaped for good surface drainage away from foundations and absorption fields.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Toledo silty clay, ponded, is one of two phases in the Toledo series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarry, is an example. This miscellaneous area is shown on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

Ag—Algansee fine sand, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on long, narrow areas on beaches. It is subject to occasional flooding caused by strong, steady northeast winds across the lake. Most areas range from 10 to 25 acres. Slope is 0 to 2 percent.

Typically, the surface layer is black, loose fine sand about 5 inches thick. The subsurface layer is very dark gray, loose fine sand about 9 inches thick. The substratum to a depth of about 60 inches is brown and dark yellowish brown, mottled, loose fine sand.

Included with this soil in mapping are small areas of very poorly drained Glendora soils in depressions and well drained Oakville soils on the tops and shoulders of beach ridges. These inclusions make up 10 to 15 percent of most areas.

Permeability of this Algansee soil is very rapid. The available water capacity is low. Runoff is slow. The seasonal high water table between depths of 12 and 24 inches is controlled by the water level in the adjacent lake. The organic matter content is moderate. The soil is neutral or mildly alkaline. The root zone is deep.

Most of the acreage of this soil is used for recreation areas or is in beach grasses and trees. This soil is not used for farming because it is sandy and occasionally flooded and has low available water capacity. It is moderately well suited to trees. The main management concerns are droughtiness and soil blowing. Beach grasses, trees, and other vegetation reduce soil blowing. Trees selected for planting should be tolerant of droughtiness. Seedling mortality can be reduced by removing competing vegetation and by mulching or watering.

This soil is generally not suited as a site for buildings and septic tank absorption fields because it floods occasionally. The sand sloughs during excavation.

This soil is in capability subclass IIIw and woodland suitability subclass 3s.

Bo—Bono silty clay. This deep, nearly level, very poorly drained soil is in irregular concave areas in depressions. It is subject to ponding (fig. 2). Most areas range from 5 to 50 acres. Slope is 0 to 2 percent.

Typically, the surface layer is black, firm silty clay about 7 inches thick. The subsurface layer is very dark gray, mottled, firm silty clay about 7 inches thick. The subsoil is gray, mottled, very firm silty clay about 31 inches thick. The substratum to a depth of about 60 inches is gray, mottled, very firm silty clay. Some areas have a thinner dark-colored surface layer.

Included with this soil in mapping are small areas of somewhat poorly drained Nappanee soils on slight rises. These inclusions make up about 5 percent of most areas.

Permeability of this Bono soil is slow or very slow. The available water capacity is moderate. Runoff is very slow or ponded. A seasonal high water table is near or above the surface in winter and spring and in other extended wet periods. The subsoil is slightly acid or neutral in the upper part and mildly alkaline or moderately alkaline in the lower part. The organic matter content is high. The root zone is mainly deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Stands of small grains are poor in some years in areas without good artificial drainage. Most areas have been drained. Subsurface drains are commonly used to lower the seasonal high water table where drainage outlets are available. Subsurface drains must be closely spaced for uniform drainage. Surface drains and drainage ditches are used in many areas to remove excess surface water. Dikes and pumps are used in some areas without drainage outlets. This soil should be worked within a narrow range of moisture content because it becomes compacted and cloddy if tilled, grazed, or harvested when wet. The soil cracks during drying. Planting cover crops and returning crop residues to the soil improve tilth and increase water infiltration.

This soil is suited to woodland. The use of planting

Figure 2.—Areas of Bono silty clay are subject to ponding.

and harvesting equipment is limited by soil wetness. Logging and planting can be done during the drier part of the year. Selecting species for planting that are tolerant of wetness and of a high clay content in the surface layer and subsoil reduces seedling mortality and the windthrow hazard.

This soil is poorly suited as a site for buildings. Building sites should be landscaped for good surface drainage away from foundations. Backfilling along foundations with a material low in shrink-swell potential and using drains at the base of footings reduce damage from the shrinking and swelling and help prevent wet basements. Exterior basement wall coatings also help prevent wet basements. If the soil is used for local roads and streets, using suitable base material and artificial drainage reduce damage from low soil strength, wetness, and shrinking and swelling. This soil is a good site for a pond reservoir area.

This soil is in capability subclass IIIw and woodland suitability subclass 3w.

ChB—Castalia very stony fine sandy loam, 1 to 6 percent slopes. This nearly level and gently sloping soil is on upland knolls and slight rises. It is moderately deep and well drained. The stones are subrounded or angular and range from 10 inches to almost 4 feet across. They are about 5 to 30 feet apart on the surface (fig. 3). Most areas are oval or irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is black, very friable very stony fine sandy loam about 7 inches thick. The subsoil is dark reddish brown and reddish brown, very friable very channery loam and extremely channery sandy loam about 13 inches thick. The substratum is yellowish red, loose extremely flaggy loamy sand. Dolomitic limestone is at a depth of 27 inches. In a few areas the surface layer is lighter colored.

Included in mapping are small areas of well drained Milton and moderately well and well drained Rawson soils that have fewer coarse fragments and more clay throughout the soil and very poorly drained Millsdale soils in depressions. Also included are small areas of rock outcrops and areas of shallow soils where bedrock is at a depth of 10 to 20 inches. These inclusions make up about 10 percent of most areas.

Permeability of the Castalia soil is rapid. The available water capacity is very low, and this soil is quite droughty during dry periods. Runoff is slow. The subsoil is mildly alkaline or moderately alkaline. The organic matter content is high. The root zone is moderately deep.

Most of the acreage is in brush. Some areas are in orchards and pasture. This soil is generally not suited to corn, soybeans, and small grains. It is poorly suited to pasture. Surface stones and droughtiness are the main limitations. The lake influences the temperature in spring, greatly reducing frost damage. In places, soil has been brought in from other areas to improve the root zone for orchards. This soil is suited to irrigation and to grazing early in spring. Grasses and legumes that adapt to droughty sites should be selected for planting.

This soil is poorly suited to woodland. Droughtiness, a limited zone favorable for root development, and surface stones are major limitations. Mulching and watering reduce seedling mortality.

This soil is poorly suited as a site for buildings and septic tank absorption fields because the surface is stony and bedrock is at a depth of 20 to 40 inches. Houses without basements are better suited to this soil than houses with basements. Blasting of bedrock is generally needed before a basement can be constructed or underground utilities installed. Stones should be removed prior to construction. The stones interfere with establishing and mowing of lawns. The effluent from septic tank absorption fields may move through fissures in the bedrock and pollute underground water supplies. Either central sewage systems should be used or septic tank absorption fields installed on elevated mounds where 4 feet or more of filtering zone is above the bedrock.

This soil is in capability subclass VIs and woodland suitability subclass 5f.

Co—Colwood loam. This deep, nearly level, very poorly drained soil is in slightly depressed, concave areas that are long and narrow and on broad flats on lake plains. It is subject to ponding. Most areas range from 5 to 100 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, very friable loam about 11 inches thick. The subsoil is about 27 inches thick. The upper part is grayish brown, mottled, friable loam, and the lower part is gray and grayish brown, mottled, friable, stratified very fine sandy loam, loam, sandy loam, and clay loam. The substratum to a depth of about 60 inches is dark grayish brown, mottled, friable loam and silt loam. In some areas the subsoil has more clay. In a few areas the soil has small gravel throughout.

Included with this soil in mapping are small areas of the somewhat poorly drained Haskins and Rimer soils on side slopes along drainageways and on slight rises and low ridges. These inclusions make up about 15 percent of most areas.

Permeability of this Colwood soil is moderate. The available water capacity is high. Runoff is very slow or ponded. This soil has a seasonal high water table near or above the surface in fall, winter, spring, and in other extended wet periods. The subsoil is neutral or slightly acid. The organic matter content is high. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are grown in some areas. Drained areas are well suited to row crops if optimum management is applied. Unless adequate drainage is provided, poor

Figure 3.—Stones on the surface of Castalia very stony fine sandy loam, 1 to 6 percent slopes, restrict the use of this soil.

stands of wheat and oats can be expected in most years. Most areas have been drained. Subsurface drains are commonly used to lower the seasonal high water table. Open ditches and surface drains are used to remove excess surface water. Tilling, harvesting, or grazing this soil when it is wet causes compaction. Planting cover crops, returning crop residue to the soil, and using conservation tillage that leaves crop residue on the soil surface improve tilth and increase water infiltration.

This soil is suited to woodland. Planting and harvesting can be done during the drier part of the year. Selecting species for planting that are tolerant of wetness reduces the windthrow hazard and seedling mortality. Plant competition can be reduced by spraying, mowing, or disking.

This soil is poorly suited as a site for buildings. Ponding severely limits this use. Building sites should be landscaped for good surface drainage away from foundations. Using drains at the base of footings and exterior basement wall coatings help prevent wet basements. Providing artificial drainage and using a suitable base material under local roads and streets reduce damage from ponding and frost heaving. Excavation is limited during winter and spring by ponding and sloughing of banks.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

DeA—Del Rey silt loam, 1 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises in long, narrow and irregularly shaped areas on lake plains. Most areas range from 5 to 25 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is dark yellowish brown and brown, mottled, firm silty clay loam about 36 inches thick. The substratum to a depth of about 60 inches is brown, mottled, firm silty clay loam. In some areas the surface layer and upper part of the subsoil are loam. In places the substratum is glacial till.

Included in mapping are small areas of very poorly drained Lenawee soils and the somewhat poorly drained Kibbie, Del Rey, and Rimer soils. Lenawee soils are on flats and in depressions. Kibbie, Rimer, and Del Rey soils are in similar positions on the landscape. These included soils make up about 15 percent of most areas.

Permeability of this Del Rey soil is slow. The available water capacity is moderate or high. Runoff is slow. A seasonal high water table is at a depth of 12 to 36 inches in winter and spring and in other extended wet periods. The subsoil is slightly acid to mildly alkaline. The organic matter content is moderate. The root zone is moderately deep to deep.

Most of the acreage is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are grown in some areas. Artificially drained areas are well suited to crops. Most areas have been drained. Wetness delays planting and limits the choice of crops. Subsurface drains are commonly used to lower the seasonal high water table. The surface layer crusts after hard rains, which has an adverse effect on seedling emergence. Returning crop residue to the soil, using conservation tillage that leaves crop residue on the soil surface, and planting cover crops reduce crusting and erosion and improve tilth and increase water infiltration. Tilling, harvesting, and grazing when the soil is wet cause soil compaction.

This soil is suited to woodland. Species selected for planting should be those that grow well in somewhat poorly drained soils with a fairly high clay content. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as a site for buildings and poorly suited to septic tank absorption fields. Seasonal wetness makes this soil better suited to buildings without basements than to buildings with basements. Building sites and septic tank absorption fields should be landscaped for good surface drainage away from foundations and absorption fields. Installing drains at the base of footings and coating exterior basement walls help prevent wet basements. If the soil is used for local roads and streets, using suitable base material and artificial drainage improve soil strength and reduce damage from frost action and seasonal wetness. Using subsurface drains around septic tank absorption fields lowers the seasonal high water table.

This soil is in capability subclass IIw and woodland suitability subclass 3c.

DuB—Dunbridge fine sandy loam, 2 to 6 percent slopes. This gently sloping, moderately deep, well drained soil is in irregularly shaped areas on sides of ridges. Most areas are 5 to 25 acres.

Typically, the surface layer is dark brown, friable fine sandy loam about 9 inches thick. The strong brown subsoil is about 25 inches thick. It is friable loam in the upper part, firm clay loam in the middle part, and friable gravelly sandy loam in the lower part. Limestone bedrock is at a depth of about 34 inches. In some areas the surface layer is sandy loam.

Included with this soil in mapping are small areas of the deep Rawson, Haskins, and Nappanee soils. The somewhat poorly drained Haskins and Nappanee soils are on toe slopes and flats. Included soils make up about 15 percent of most areas.

Permeability of this Dunbridge soil is moderately rapid. The available water capacity is low. Runoff is medium. This soil is droughty during extended dry periods. The subsoil is slightly acid in the upper part and neutral or mildly alkaline in the lower part. The organic matter content is moderate. The root zone is deep.

Most of the acreage of this soil is in orchards and vineyards but is gradually shifting to urban uses. This soil is suited to corn, soybeans, small grains, hay, and pasture. It is especially well suited to early maturing crops. This soil warms and dries early in the spring, permitting early planting and grazing. Droughtiness is the main management concern, because this soil has a low capacity for holding moisture. Conservation of moisture is important. Returning crop residue to the soil, planting cover crops, and using conservation tillage that leaves crop residue on the soil surface reduce soil loss by erosion, improve tilth, and conserve moisture.

This soil is suited to woodland. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as a site for buildings and poorly suited to septic tank absorption fields. Because bedrock is at a depth of 20 to 40 inches, this soil is better suited to houses without basements than to houses with basements. Blasting is sometimes used to excavate for basements and to install underground utilities. Backfilling along foundations with material that has a low shrink-swell potential reduces damage from shrinking and swelling of the soil. The effluent from sanitary facilities may move through fissures in the bedrock and pollute underground water supplies. Either a central sewage system should be used or the septic tank absorption field should be installed on elevated mounds in which 4 feet or more of soil with good filtering ability covers the bedrock. If the soil is used for roads and streets, replacing the surface layer and subsoil with a good base material reduces damage from frost action and shrinking and swelling.

This soil is in capability subclass IIIs and woodland suitability subclass 3o.

Gn—Genesee silt loam, frequently flooded. This deep, nearly level, well drained soil is in long, narrow areas on flood plains of major streams. It is subject to frequent brief flooding. Most areas range from 10 to 100 acres. Slope is 0 to 2 percent.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, friable silt loam and loam in the upper and middle parts and dark yellowish brown, mottled, firm loam in the lower part. In places the soil has mottling in the middle part of the substratum. In a few areas the soil has more sand and less clay throughout.

Included with this soil in mapping are small areas of Haskins, Rawson, Wabasha, and Genesee Variant soils. The very poorly drained Wabasha soils are in depressions on the flood plains. The somewhat poorly drained Haskins soils and moderately well drained Rawson soils are on terraces. The moderately deep, well drained Genesee Variant soils are in areas where streams flow over bedrock. These inclusions make up 10 to 15 percent of most areas.

Permeability of this Genesee soil is moderate. The available water capacity is high or very high. Runoff is slow. The soil is neutral or slightly acid in the upper part and mildly alkaline or moderately alkaline in the lower part. The organic matter content is moderate. The root zone is deep.

Most of the acreage of this soil is cropland. Corn and soybeans are the principal crops. This soil is well suited to corn and soybeans, but poorly suited to winter wheat. The main management concern is the flooding hazard. Flooding occurs during brief periods of high runoff from surrounding land, especially when the soil is frozen and ice jams the stream channels. Levees can be used to protect areas from flooding. Keeping stream channels free of obstructions, such as logs and treetops, reduces flooding. Controlled grazing should be used to reduce soil compaction when the soil is wet. Returning crop residue to the soil, planting cover crops, and using conservation tillage that leaves crop residue on the soil surface help maintain the organic matter content and protect the surface from scouring during floods.

This soil is well suited to woodland. Plant competition can be reduced by spraying, mowing, or disking. Species selected for planting should be able to withstand flooding.

This soil is generally not suited as a site for buildings and septic tank absorption fields because it is frequently flooded. Fills for roads should not block the flow of floodwaters. This soil is suited to paths and trails during the nonflooding season.

This soil is in capability subclass IIw and woodland suitablity subclass 1o.

Go—Genesee Variant loam, frequently flooded. This moderately deep, nearly level, well drained soil is in long, narrow areas on flood plains along major streams. It is subject to frequent brief flooding. Most areas range from 10 to 50 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, very friable loam about 8 inches thick. The substratum is brown, mottled, friable silt loam in the upper part and dark brown, mottled, firm silty clay loam in the lower part. Dolomitic limestone bedrock is at a depth of about 30 inches. In a few areas gray mottles are in the lower part of the substratum.

Included with this soil in mapping are small areas of Rawson soils on terraces and a few small areas of rock outcrops. These inclusions make up 5 to 10 percent of most areas.

Permeability of this Genesee soil is moderate. This soil has a low available water capacity and is droughty during dry periods. Runoff is slow. The soil is neutral or mildly alkaline throughout. The organic matter content is moderate. The root zone is moderately deep to bedrock.

Many areas of this soil are cropland. This soil is suited to corn and soybeans but poorly suited to winter wheat. The main management concerns are frequent flooding and droughtiness. Flooding commonly occurs when the soil is frozen and ice jams the stream channels. Levees can be used to protect areas from flooding. Keeping stream channels free of obstructions, such as logs and treetops, reduces flooding. Controlled grazing should be used to reduce soil compaction when the soil is wet. Returning crop residue to the soil, planting cover crops, and using conservation tillage that leaves crop residue on the soil surface will conserve moisture, help maintain the organic matter content, and protect the surface from scouring during floods.

Many areas of this soil are used for woodland. This soil is suited to trees. Plant competition can be reduced by spraying, mowing, or disking. Species selected for planting should be tolerant of a low available water capacity and be able to withstand flooding.

This soil is generally not suited as a site for buildings and septic tank absorption fields because it is frequently flooded. Fills for roads should not block the flow of floodwaters.

This soil is in capability subclass IIIw and woodland suitability subclass 3o.

Gr—Glendora loamy fine sand, frequently flooded. This deep, nearly level, very poorly drained soil is in long, narrow depressions between beach ridges. It is subject to frequent flooding from the lake throughout the year. Most areas range from 15 to 50 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, loose loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is dark gray, grayish brown, and gray, loose fine sand and sand. It is mottled in the upper few inches. In a few areas muck layers are throughout the soil.

Included with this soil in mapping are small areas of the Toledo ponded and Algansee soils. The Toledo soil is similar in position on the landscape to this soil, and the Algansee soils are slightly higher. These inclusions make up 10 to 15 percent of most areas.

Permeability of this Glendora soil is rapid. The rooting depth is influenced by the water table. The available water capacity is low. Runoff is very slow. The seasonal high water table is near the surface much of the year. The organic matter content is high. The root zone below the surface layer is neutral or mildly alkaline in the upper part and moderately alkaline in the lower part.

Most areas are used as habitat for wetland wildlife. This soil is well suited to habitat for wetland wildlife, especially muskrat and other animals that den or nest near water.

This soil is generally not suited to woodland. Most trees have little commercial value. Planting can be done during the drier part of the year; however, growth is poor. Species selected for planting should be tolerant of wetness to reduce seedling mortality and the windthrow hazard.

This soil is generally not suited as a site for buildings and septic tank absorption fields because it floods, is wet, and is a poor filter.

This soil is in capability subclass Vw and woodland suitability subclass 5w.

HaA—Haskins loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is in long, narrow areas on terraces along streams and in irregularly shaped areas on lake plains. Most areas range from 5 to 25 acres.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsoil is about 42 inches thick. The upper and middle parts are dark yellowish brown and yellowish brown, mottled, friable sandy clay loam and clay loam; and the lower part is dark grayish brown, mottled, very firm silty clay. The substratum to a depth of about 60 inches is brown, mottled, very firm silty clay loam. In a few areas the surface layer is darker colored, and in other areas it is sandy loam. In some areas more clay and less sand are in the upper and middle parts of the subsoil. A few areas are subject to flooding on rare occasions.

Included with this soil in mapping are small areas of very poorly drained Hoytville and Toledo soils on flats. These inclusions make up about 15 percent of most areas.

Permeability of this Haskins soil is moderate in the upper part of the profile and slow or very slow in the lower part. The available water capacity is moderate. Runoff is slow. A perched seasonal high water table is between depths of 12 and 30 inches in winter and spring and in other extended wet periods. The subsoil is medium acid to mildly alkaline. The organic matter content is moderate. The root zone is moderately deep to deep. Roots are restricted by the compact glacial till or lacustrine material.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are also grown in some areas. Artificially drained areas are well suited to crops. Subsurface drains are commonly used to lower the seasonal high water table. These drains are more effective if placed above the slowly or very slowly permeable material in the lower part of the subsoil and in the substratum. Open ditches and surface drains are used to remove excess surface water. Drop structures are used to reduce erosion where surface water enters open ditches (fig. 4). Tilling, grazing, or harvesting when the soil is wet causes compaction. Planting cover crops, returning crop residue to the soil, and using conservation tillage that leaves crop residue on the soil surface improve tilth and increase water infiltration.

This soil is well suited to woodland. Species selected for planting should be tolerant of some wetness. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as a site for buildings and poorly suited to septic tank absorption fields. Seasonal wetness makes this soil better suited to buildings without basements than to buildings with basements. Building sites and septic tank absorption fields should be landscaped for good surface drainage away from foundations and absorption fields. Installing drains at the base of footings and coating exterior basement walls help prevent wet basements. Local streets and roads can be improved by using suitable base material, and artificial drainage can be provided to reduce the damage from frost action and seasonal wetness. Using subsurface drains around septic tank absorption fields lowers the seasonal high water table.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

Hy—Hoytville silty clay loam. This deep, nearly level, very poorly drained soil is on broad flats and in long, narrow, concave areas on lake plains. Most areas range from 5 to more than 100 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is grayish brown and dark grayish brown, mottled, firm silty clay about 39 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, very firm silty clay loam. Coarse fragments typically make up 4 to 6 percent of the subsoil and 10 percent of the substratum. In some areas the surface layer is loam or silty clay, and in other areas the subsoil and substratum have less gravel.

Included with this soil in mapping are small areas of somewhat poorly drained Nappanee and Haskins soils

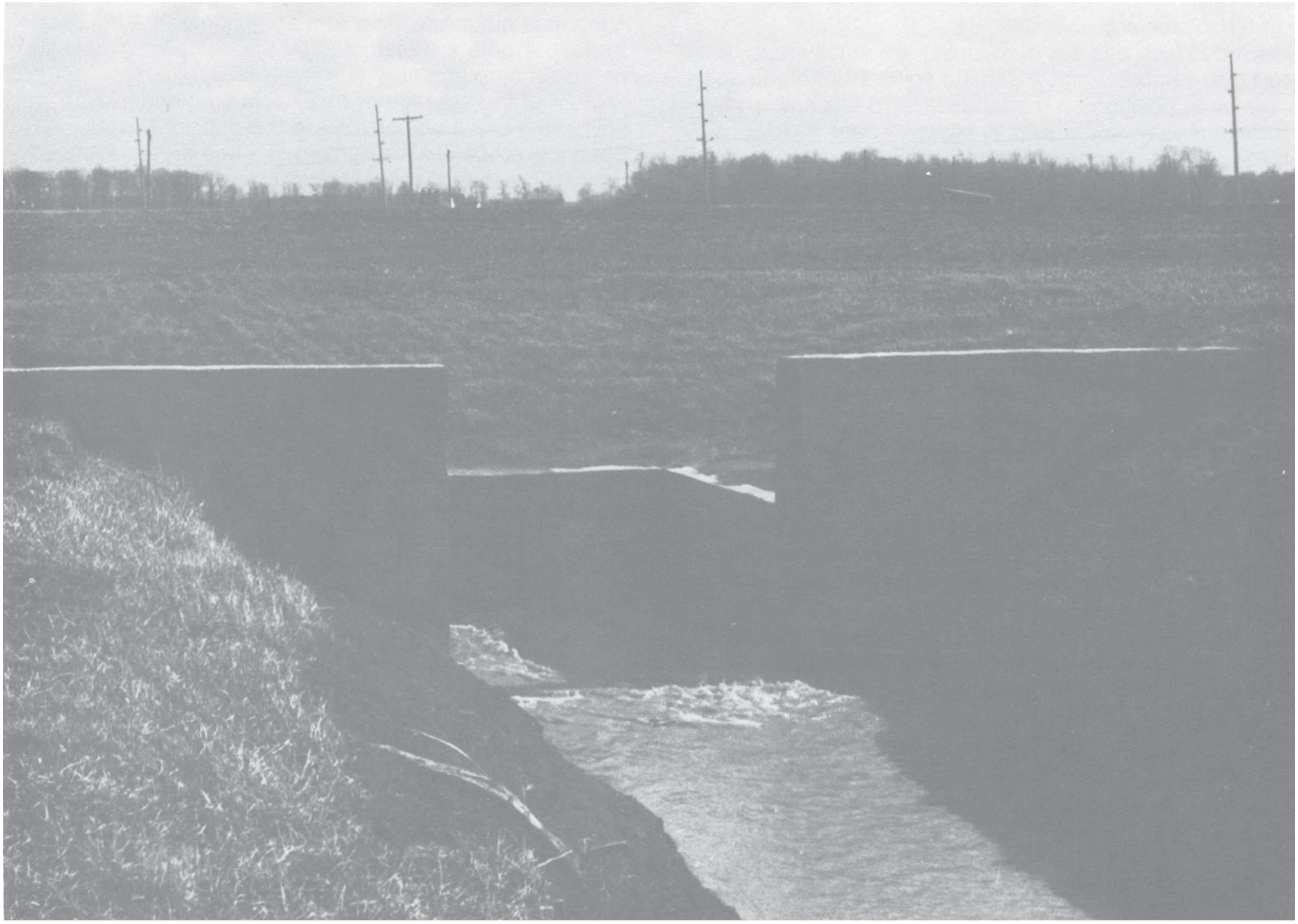

Figure 4.—A drop structure is commonly used to reduce erosion where surface water enters open drainage ditches. This structure is on Haskins loam, 0 to 3 percent slopes.

on oval knolls and on side slopes along drainageways. Also included are areas of very poorly drained soils with bedrock at a depth of 20 to 40 inches. These inclusions make up 5 to 15 percent of most areas.

Permeability of this Hoytville soil is slow. The available water capacity is moderate. Runoff is very slow or ponded. This soil has a seasonal high water table near or above the surface in winter and spring and in other extended wet periods. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The organic matter content is high. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are also grown in drained areas, which are well suited to crops. Most areas have been drained. Subsurface drains are commonly used to lower the seasonal high water table. Open ditches and surface drains are used to remove excess surface water. This soil should be tilled, harvested, and grazed within a narrow range of moisture content because it becomes compacted and cloddy if worked when wet. Compaction restricts seedling emergence and plant growth. Using conservation tillage that leaves crop residue on the soil surface, planting cover crops, and returning crop residue to the soil will improve tilth and increase water infiltration.

This soil is suited to woodland. Planting and harvesting can be done during the drier part of the year. Selecting species for planting that are tolerant of wetness and of a high clay content in the subsoil improves growth and reduces seedling mortality and windthrow hazard.

Removing excess water from the soil also reduces seedling mortality.

Even though this soil is used as a site for buildings, it is poorly suited to this purpose. Houses without basements are better suited to this soil than houses with basements. Building sites should be landscaped for good surface drainage away from the foundations. Backfilling along foundations with a low shrink-swell material and using drains at the base of footings will reduce damage from shrinking and swelling of the soil. The drains and exterior basement wall coatings help prevent wet basements. If the soil is used for local roads and streets, using a suitable base material and providing artificial drainage reduce the damage from frost action, wetness, low soil strength, and the shrinking and swelling of the soil. This soil is a good site for a pond reservoir area.

This soil is in capability subclass IIw and woodland suitability subclass 3w.

KfA—Kibbie fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight rises and broad flats on lake plains. Most areas are broad or long and narrow and range from 5 to 50 acres.

Typically, the surface layer is very dark gray, very friable fine sandy loam about 9 inches thick. The subsoil is about 28 inches thick. The upper part is dark grayish brown, mottled, friable loam; and the middle and lower parts are yellowish brown, mottled, very friable and friable, stratified loam and silty clay loam. The substratum to a depth of about 60 inches is brown and grayish brown, mottled, friable, stratified silt loam and silty clay loam. In some areas the surface layer is lighter colored. In places the subsoil and substratum have more fine sand.

Included in mapping are small areas of Del Rey, Rimer, Colwood, and Lenawee soils. The somewhat poorly drained Del Rey and Rimer soils are similar in position to the Kibbie soil and have a lighter colored surface layer. The very poorly drained Colwood and Lenawee soils are on flats and in depressions. These inclusions make up 10 to 20 percent of most areas.

Permeability of this Kibbie soil is moderate. The available water capacity is high. Runoff is slow. A seasonal high water table is at a depth of 12 to 24 inches in fall, winter, spring, and in other extended wet periods. The subsoil is slightly acid or neutral. The organic matter content is moderate. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are grown in some areas. Artificially drained areas are well suited to crops and specialty crops (fig. 5). Most of the acreage has been drained. Subsurface drains are commonly used to lower the seasonal high water table. Tilling, harvesting, and grazing this soil when it is wet causes compaction. Plowed areas and other unvegetated areas are subject to soil blowing. This blowing severely damages young corn, soybeans, and vegetable plants. Planting cover crops, using conservation tillage that leaves crop residue on the soil surface, and returning crop residue to the soil will reduce damage from soil blowing and increase water infiltration. Windbreaks also reduce soil blowing. Frost heaving severely damages winter wheat.

This soil is well suited to woodland. Species selected for planting should be tolerant of some wetness. Plant competition can be reduced by disking, spraying, or mowing.

This soil is moderately well suited as a site for buildings and septic tank absorption fields. It is better suited to houses without basements than to houses with basements. Building sites should be landscaped for good surface drainage away from foundations. Drains at the base of footings and exterior basement wall coatings help keep basements dry. Perimeter drains are needed around septic tank absorption fields to lower the seasonal high water table. Sloughing is a hazard in excavations. If the soil is used for local roads and streets, using a suitable base material and providing drainage reduce damage from frost action and seasonal wetness.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

Lc—Latty silty clay. This deep, nearly level, very poorly drained soil is on broad flats and in long, narrow, concave areas on lake plains. It is subject to ponding. Most areas range from 5 to 100 acres. Slope is 0 to 2 percent.

Typically, the surface layer is dark gray, firm silty clay about 9 inches thick. The subsoil is gray, mottled, firm silty clay about 36 inches thick. The substratum to a depth of about 60 inches is gray, mottled, firm silty clay. In some areas the surface layer is darker colored.

Included with this soil in mapping are small areas of Nappanee and Hoytville soils. The somewhat poorly drained Nappanee soils are on slight rises and ridges. The very poorly drained Hoytville soils have a darker colored surface layer and are along drainageways and in depressions. Also included are small areas where the surface layer is loam or sandy loam. These inclusions make up about 15 percent of most areas.

Permeability of this Latty soil is very slow. The available water capacity is moderate. Runoff is very slow or ponded. This soil has a high water table near or above the surface in winter and spring and in other extended wet periods. The subsoil is slightly acid or neutral. The organic matter content is moderate. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are also grown in some areas. Drained areas are suited to crops and pasture. Most of the

Figure 5.—Kibbie fine sandy loam, 0 to 2 percent slopes, is well suited to cabbage.

acreage has been drained. Subsurface drains are commonly used to lower the seasonal high water table. Subsurface drains must be closely spaced for uniform drainage because movement of water into these drains is slow.

Open ditches and surface drains are also used to remove excess surface water. This soil should be worked within a narrow range of moisture content because it becomes compacted and cloddy if tilled, grazed, or harvested when wet. Compaction reduces seedling emergence and plant growth. Planting cover crops and returning crop residue to the soil will improve tilth, reduce crusting, and increase water infiltration.

This soil is suited to woodland. Logging and planting can be done during the drier parts of the year. Selecting species that are tolerant of wetness and of a clayey subsoil reduces seedling mortality and the windthrow hazard.

A few areas of this soil are sites for buildings, but it is poorly suited to this use. Buildings without basements are better suited to this soil than buildings with basements. Building sites should be landscaped for good surface drainage away from foundations. Backfilling along foundations with a material low in shrink-swell potential and using drains at the base of footings reduce damage from the shrinking and swelling of the soil and help prevent wet basements. Exterior basement wall coatings are commonly used to help prevent wet basements. If the soil is used for local roads and streets, using suitable base material and providing artificial drainage reduce the damage from low soil strength, wetness, and the shrinking and swelling of the soil. This soil is a good site for pond reservoir areas.

This soil is in capability subclass IIIw and woodland suitability subclass 3w.

Lf—Lenawee silty clay loam. This deep, nearly level, very poorly drained soil is on lake plains. It is in irregularly shaped areas on flats and in long, narrow, concave areas. It is subject to ponding. Most areas range from 5 to 75 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, friable silty clay loam about 9 inches thick. The subsoil is grayish brown and gray, mottled, firm and friable silty clay loam about 40 inches thick. The substratum to a depth of about 60 inches is gray, mottled, firm silty clay loam. In some areas the subsoil is thinner, and in other areas the surface layer is loam.

Included with this soil in mapping are small areas of Del Rey, Haskins, Kibbie, Nappanee, and Hoytville soils. The somewhat poorly drained Del Rey, Haskins, Kibbie, and Nappanee soils are on slight rises and on side slopes along drainageways. Small areas of very poorly drained Hoytville soils have more clay in the subsoil and are similar in position to the Lenawee soil. These inclusions make up about 15 percent of most areas.

Permeability of this Lenawee soil is moderately slow. The available water capacity is high. Runoff is very slow or ponded. This soil has a seasonal high water table near or above the surface in fall, winter, spring, and in other extended wet periods. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The organic matter content is high. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are also grown in drained areas. Drained areas are well suited to crops and pasture. Most of the acreage has been drained. Subsurface drains are commonly used to lower the seasonal high water table. Open ditches and surface drains are used to remove excess surface water. Tilling, harvesting, and grazing this soil when it is wet cause compaction and cloddiness and decrease tilth and water infiltration. Compaction interferes with seedling emergence and plant growth. Planting cover crops and returning crop residue to the soil will improve tilth and increase water infiltration.

This soil is well suited to woodland. Planting and harvesting can generally be done during the drier part of the year. Selecting species that are tolerant of wetness reduces seedling mortality and increases growth. Plant competition can be reduced by spraying, mowing, or disking.

This soil is used as a site for buildings, but it is poorly suited to this purpose. Buildings without basements are better suited to this soil than buildings with basements. Building sites should be landscaped for good surface drainage away from foundations. Backfilling along basement walls with a low shrink-swell material and using drains at the base of footings reduce damage from the shrinking and swelling of the subsoil and help prevent wet basements. Exterior basement wall coatings are also commonly used to help prevent wet basements. Using a suitable base material and providing artificial drainage for local roads and streets reduce damage from wetness, frost action, and low soil strength.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Mh—Millsdale silty clay loam. This moderately deep, nearly level, very poorly drained soil is in depressions and on flats on lake plains. It is subject to ponding. Most areas range from 5 to 50 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, very friable silty clay loam about 10 inches thick. The subsoil is about 19 inches thick. The upper part is grayish brown, mottled, friable and firm silty clay loam, and the lower part is brown, mottled, firm silty clay loam. Limestone bedrock is at a depth of about 29 inches. In some areas the surface layer is lighter colored. In places the surface layer is silt loam.

Included in mapping are small areas of Hoytville, Milton, and Nappanee soils. The very poorly drained Hoytville and Nappanee soils are deep to bedrock. The well drained Milton soils and somewhat poorly drained Nappanee soils are on slight rises. These inclusions make up about 15 percent of most areas.

Permeability of this Millsdale soil is moderately slow. The available water capacity is low. Runoff is very slow or ponded. A seasonal high water table is near or above the surface in winter and spring and in other extended wet periods. The subsoil is neutral or mildly alkaline. Organic matter content is high. The rooting zone is moderately deep to limestone bedrock.

Most of the acreage is used for general farming. Corn, soybeans, and small grains are the principal crops. This soil is moderately well suited to crops and pasture. Drainage and the moderate depth to bedrock are the main management concerns. Subsurface and surface drains are used to remove excess water; however, the bedrock at a depth of 20 to 40 inches makes it difficult to locate good outlets in many areas, especially for subsurface drains. This soil should be tilled, harvested, and grazed within a narrow range of moisture content because it becomes compacted and cloddy when wet. Compaction interferes with seedling emergence and plant growth. Planting cover crops and returning crop residue to the soil improve tilth and increase water infiltration.

This soil is moderately well suited to woodland. Planting and harvesting can generally be performed during the drier part of the year. Species selected for planting should be tolerant of wetness to improve growth and reduce the windthrow hazard and seedling mortality.

This soil is poorly suited as a site for buildings because it ponds and limestone bedrock is at a depth of 20 to 40 inches. Houses without basements are better suited to this soil than houses with basements. Building sites should be landscaped for good surface drainage away from foundations. Backfilling along foundations with a low shrink-swell material and using drains at the base of footings reduce damage from shrinking and swelling of the soil. The drains and exterior basement wall coatings help prevent wet basements. If this soil is used for local roads and streets, using a suitable base material and providing artificial drainage reduce damage from frost action, wetness, and low soil strength.

This soil is in capability subclass IIIw and woodland suitability subclass 2w.

MtB—Milton silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on knolls and flats. Most areas are oval or irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is brown, firm and very firm silty clay and clay loam about 30 inches thick. Limestone bedrock is at a depth of about 36 inches. In some areas the surface layer is silty clay loam. In places bedrock is at a depth of more than 40 inches, and the subsoil has more sand and less clay.

Included in mapping are small areas of Castalia, Millsdale, and Nappanee soils. The well drained Castalia soils have more sand and rock fragments in the subsoil than the Milton soil. The very poorly drained Millsdale soils and deep, somewhat poorly drained Nappanee soils are in depressions and seeps and on the lower part of side slopes. These inclusions make up about 15 percent of most areas.

Permeability of this Milton soil is moderately slow. It has a low available water capacity. Runoff is medium. This soil is quite droughty during extended dry periods. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The organic matter content is moderate. The root zone is moderately deep.

Most of the acreage of this soil is in old orchards and vineyards. Some areas are used for general farming. This soil is suited to corn, soybeans, and small grains. It is well suited to early maturing crops. Because this soil warms early in spring, it can be planted and grazed early. The lake moderates temperatures in spring, which greatly reduces frost damage. Because this soil has a low capacity to hold moisture, conservation of moisture is important. The surface layer crusts after hard rains, which has an adverse effect on seedling emergence. Returning crop residue to the soil, using conservation tillage that leaves crop residue on the soil surface, and planting cover crops reduce crusting and erosion, improve tilth, and increase water infiltration.

This soil is well suited to woodland. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as a site for buildings and poorly suited to septic tank absorption fields. Because of the hard bedrock at a depth of 20 to 40 inches, this soil is better suited to houses without basements than to houses with basements. Blasting of bedrock is generally needed before a basement can be constructed or underground utilities can be installed. Backfilling along foundations with material that has a low shrink-swell potential reduces damage from shrinking and swelling of the soil. The effluent from sanitary facilities may move through fissures in the bedrock and pollute underground water supplies. Either community sewage systems should be used or septic tank absorption fields should be installed on elevated mounds with 4 feet or more of filtering zone above the bedrock. If this soil is used for roads and streets, the surface layer and subsoil should be replaced with a good base material.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

NpA—Nappanee silty clay loam, 0 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on slight convex rises and side slopes along drainageways on lake plains. Most areas range from 4 to 75 acres.

Typically, the surface layer is grayish brown, friable silty clay loam about 8 inches thick. The subsoil is dark brown, mottled, firm silty clay about 26 inches thick. The substratum to a depth of about 60 inches is dark brown, mottled, very firm silty clay. In some areas the surface layer is silt loam, and in other areas the surface layer is darker colored.

Included with this soil in mapping are small areas of Hoytville, Latty, Lenawee, Toledo, and St. Clair soils. The very poorly drained Hoytville, Latty, Lenawee, and Toledo soils are on flats and in depressions and along poorly defined drainageways. The moderately well drained St. Clair soils are included on slope breaks along drainageways. These inclusions make up about 15 percent of most areas.

Permeability of this Nappanee soil is slow. The available water capacity is moderate. Runoff is slow. A perched seasonal high water table is between depths of 1 and 2 feet in fall, winter, spring, and extended wet periods. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The organic matter content is moderately low. The root zone is mainly restricted to the moderately deep zone above the compact glacial till.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are grown in some areas. Artificially drained areas are suited to crops and pasture. Most of the acreage has been drained. Subsurface drains are commonly used to lower the seasonal high water table, but movement of water into subsurface drains is slow. Drainage lines must be closely spaced for uniform drainage. The surface layer crusts after hard rains, which has an adverse effect on seedling emergence. Returning crop residue to the soil, planting cover crops, and using conservation tillage that leaves crop residue on the soil surface reduce crusting and erosion, improve tilth, and increase water infiltration. Tilling, harvesting, or grazing when the soil is wet causes compaction and interferes with seedling emergence.

This soil is suited to woodland. Species selected for planting should be tolerant of the clayey subsoil and some seasonal wetness in order to reduce the seedling mortality and windthrow hazard. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited as a site for buildings and poorly suited to septic tank absorption fields. Buildings without basements are better suited to this soil than buildings with basements. Building sites and septic tank absorption fields should be landscaped for good surface drainage away from foundations and absorption fields. Backfilling along foundations with material low in shrink-swell potential, using drains at the base of footings, and coating exterior basement walls reduce damage from shrinking and swelling and help prevent wet basements. If this soil is used for local streets and roads, using suitable base material and providing artificial drainage reduce damage from frost action, wetness, and shrinking and swelling of the soil. Using subsurface drains around septic tank absorption fields lowers the seasonal high water table.

This soil is in capability subclass IIIw and woodland suitability subclass 3c.

OaB—Oakville fine sand, 2 to 8 percent slopes. This deep, gently sloping, well drained soil is in long, narrow areas on beach ridges along a lake. Most areas range from 5 to 50 acres.

Typically, the surface layer is very dark gray, loose fine sand about 4 inches thick. The subsoil is yellowish brown, loose fine sand about 36 inches thick. The substratum to a depth of about 60 inches is brown, loose fine sand. The surface layer is very thin or absent in some areas.

Included with this soil in mapping are small areas of very poorly drained Glendora soils in depressions and somewhat poorly drained Algansee soils on flats. These inclusions make up 5 to 10 percent of most areas.

Permeability of this Oakville soil is rapid. It has a low available water capacity. Runoff is slow. This soil is droughty. The subsoil is slightly acid or medium acid. The organic matter content is low. The root zone is deep.

Most of the acreage of this soil is in native beach grasses and trees. Some areas are used as bathing beaches. This soil is poorly suited to farming and is not used for this purpose. The main management concerns are droughtiness, soil blowing, and shore erosion from wave action.

This soil is moderately well suited to woodland. Beach grasses, trees, and other vegetation reduce soil blowing. Trees selected for planting should be tolerant of dryness. They should be planted early in spring and mulched and watered to reduce seedling mortality.

This soil is suited as a site for buildings but is not commonly used for this purpose because of its proximity to the lake. The effluent from septic tank absorption fields is readily absorbed, but if it is not adequately filtered, lake and ground- water supplies may become contaminated. Sloughing is a hazard in excavations. Soil blowing is a hazard during construction. A vegetative cover maintained on the site during construction helps to prevent erosion. Riprap is commonly used along the shore to reduce erosion by wave action. Lawns seeded during the drier part of the growing season are generally a failure if they are not mulched and watered. The loose, sandy surface layer limits most recreation uses.

This soil is in capability subclass IVs and woodland suitability subclass 3s.

Pt—Pits, quarry. This map unit consists of surface-mined areas from which limestone bedrock has been removed for use in construction. They are mainly areas where limestone bedrock is close to the surface. Typically, they are adjacent to areas of Castalia, Millsdale, and Milton soils. Most quarries range from 5 to more than 200 acres. Actively mined quarries are continually being enlarged. They characteristically have a high wall on one or more sides.

The material remaining after mining is poorly suited to plants. The organic matter content and the available water capacity are very low. Most inactive quarries contain water and are used for fishing, swimming, and other aquatic recreation. The areas surrounding most quarries have been leveled and planted to shrubs and grass.

This map unit is not assigned to a capability subclass or woodland suitability subclass.

RaB—Rawson loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained and well drained soil is in long, narrow areas on terraces along major streams and in irregularly shaped areas on lake plains. Most areas range from 5 to 20 acres.

Typically, the surface layer is dark brown, friable loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is dark yellowish brown, mottled, friable gravelly loam and clay loam; and the lower part is dark yellowish brown and brown, mottled, very firm silty clay loam. In places the surface layer is thinner or lighter colored. In some areas more coarse fragments are in the subsoil, and in other small areas bedrock is at a depth of 20 to 40 inches.

Included in mapping are small areas of Genesee, Haskins, and Nappanee soils. The well drained Genesee soils are on flood plains and are subject to flooding. Haskins and Nappanee soils are on foot slopes and slight rises and are somewhat poorly drained. These inclusions make up about 10 percent of most areas.

Permeability of this Rawson soil is moderate in the upper part of the subsoil and slow or very slow in the lower part and in the substratum. The available water capacity is moderate. Runoff is medium. A perched water table is between depths of 30 and 48 inches in winter and spring and in other extended wet periods. The subsoil is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part. The organic matter content is moderate. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Orchards and vineyards are also grown. This soil is well suited to crops. Soil erosion is the main management concern; however, droughtiness reduces crop growth during extended dry periods. Crops respond well to irrigation. Planting cover crops, returning crop residue to the soil, and using conservation tillage that leaves crop residue on the soil surface reduce soil loss by erosion. Natural drainage is generally adequate for grain and livestock farming. Tilling, harvesting, or grazing when the soil is wet causes compaction and interferes with seedling emergence.

This soil is suited to woodland. Plant competition can be reduced by spraying, mowing, or disking.

This soil is suited as a site for buildings and poorly suited to septic tank absorption fields. Seasonal wetness and moderate shrink-swell potential in the lower part of the subsoil and in the substratum, make this soil better suited to buildings without basements than to buildings with basements. Backfilling along foundations with a material that has low shrink-swell potential, using drains at the base of footings, and coating exterior basement walls will reduce damage from shrinking and swelling of the soil and help prevent wet basements. Using a suitable base material under local roads and streets reduces damage from frost action. Installing the distribution lines of septic tank absorption fields in elevated mounds of moderately or moderately rapidly permeable soil material increases the capacity of the soil to absorb effluent.

This soil is in capability subclass IIe and woodland suitabilitv subclass 2o.

RmA—Rimer loamy fine sand, stratified substratum, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is in long, narrow areas on slight rises. It is on low beach ridges on lake plains. Most areas range from 4 to 25 acres.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsoil is about 28 inches thick. The upper part is grayish brown and dark yellowish brown, mottled, very friable loamy fine sand and sandy loam; and the lower part is dark brown, mottled, firm silty clay. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm silty clay loam and friable silt loam. In some areas the surface layer is darker colored. In places the thickness of the sandy and loamy materials in the surface layer and upper part of the subsoil is quite variable. In some areas more clay is in the lower part of the subsoil and in the substratum.

Included with this soil in mapping are small areas of the Colwood, Lenawee, Haskins, Kibbie, and Del Rey soils. The very poorly drained Colwood and Lenawee soils are on flats and in depressions. The somewhat poorly drained Haskins, Kibbie, and Del Rey soils have more clay and less sand in the upper part of the subsoil and are similar in position to the Rimer soil. These inclusions make up 10 to 20 percent of most areas.

Permeability of this Rimer soil is rapid in the upper part of the profile and slow in the lower part. The available water capacity is moderate. Runoff is slow. A perched seasonal high water table is between depths of 12 and 30 inches in winter and spring and in other extended wet periods. The subsoil is strongly acid to neutral in the upper part and mildly alkaline to slightly acid in the lower part. The organic matter content is moderate. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are grown in some areas. Artificially drained areas are suited to crops. Most of the acreage has been drained. Subsurface drains are commonly used to lower the perched seasonal high water table. These drains are more effective if placed above the slowly permeable material in the lower part of the subsoil and in the substratum. Plowed and other unvegetated areas are subject to soil blowing. This blowing severely damages young corn, soybean, and vegetable plants. Planting cover crops, returning crop residue to the soil, and using conservation tillage that leaves crop residue on the soil surface reduce damage from soil blowing. Windbreaks also reduce soil blowing. Frost heaving severely damages winter wheat.

This soil is well suited to woodland. Seedling mortality can be reduced by mulching and reducing plant competition. Plant competition can be reduced by spraying, mowing, or disking.

Some areas of this soil are sites for buildings. This soil is moderately well suited as a site for buildings and poorly suited to septic tank absorption fields. Seasonal wetness makes this soil better suited to buildings without basements than to buildings with basements. Building sites and septic tank absorption fields should be landscaped for good surface drainage away from foundations. Drains at the base of footings and exterior basement wall coatings intercept water moving laterally above the slowly permeable material in the lower part of the subsoil and in the substratum. They also help prevent wet basements. Using subsurface drains around septic tank absorption fields lowers the seasonal high water table. If this soil is used for local roads and streets, using a suitable base material and providing drainage reduce damage from frost action and seasonal wetness. Sloughing is a hazard in excavation. Lawns are droughty during dry periods. New seedings should be mulched and watered.

This soil is in capability subclass IIw and woodland suitability subclass 2s.

SbC2—St. Clair silty clay loam, 4 to 12 percent slopes, eroded. This deep, gently sloping and sloping, moderately well drained soil is in long, narrow areas along streams on lake plains. Erosion has removed part of the original surface layer. The present surface layer contains subsoil material that has a higher clay content. Most areas range from 5 to 20 acres.

Typically, the surface layer is dark brown, friable silty clay loam about 7 inches thick. The subsoil is dark yellowish brown, mottled, firm silty clay about 16 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown and dark brown, mottled, very firm silty clay. In places the surface layer is thinner.

Included with this soil in mapping are small areas of Hoytville, Toledo, Wabasha, and Nappanee soils. The very poorly drained Hoytville, Toledo, and Wabasha soils are along drainageways. Narrow strips of the somewhat poorly drained Nappanee soils are at the base of side slopes. These inclusions make up about 15 percent of most areas.

Permeability of this St. Clair soil is slow or very slow. The available water capacity is moderate or low. A perched seasonal high water table is between depths of 24 and 36 inches in spring and in other extended wet periods. The subsoil is neutral to medium acid in the upper part and mildly alkaline or moderately alkaline in the lower part. The organic matter content is moderately low. The root zone is mainly restricted to the moderately deep zone above the compact glacial till.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. This soil is suited to crops and pasture. Because this soil has low or moderate available water capacity and poor tilth and is subject to erosion, droughtiness is a management concern. Using conservation tillage that leaves crop residue on the soil surface, planting cover crops, and returning crop residue to the soil help prevent excessive erosion, improve soil tilth, and increase water infiltration. Grassed waterways are used where runoff water collects. Natural drainage is generally adequate for farming. Tilling, harvesting, and grazing when the soil is wet cause compaction and reduce seedling emergence. Tillage and harvesting should be done when the soil is at an optimum moisture content.

This soil is suited to woodland. Species selected for planting should be tolerant of a high clay content in the subsoil in order to reduce seedling mortality and the windthrow hazard. Seedling mortality can also be reduced by mulching and by reducing plant competition.

This soil is moderately well suited as a site for buildings and poorly suited to septic tank absorption fields. Because this soil is seasonally wet and has a high shrink-swell potential, it is better suited to buildings without basements than to buildings with basements. Backfilling along foundations with a material low in shrink-swell potential, using drains at the base of footings, and coating exterior basement walls will reduce damage from shrinking and swelling of the soil and help prevent wet basements. The distribution lines in septic tank absorption fields should be on the contour to reduce seepage of effluent to the soil surface. The increased runoff and erosion that occur during construction can be reduced by maintaining soil cover wherever possible. If this soil is used for local streets and roads, using suitable fill material and providing artificial drainage reduce the damage from shrinking and swelling and improve soil strength. Using subsurface drains around septic tank absorption fields lowers the seasonal high water table. Increasing the size of the absorption field will also improve these fields.

This soil is in capability subclass IIIe and woodland suitability subclass 3c.

Sh—Shoals silt loam, frequently flooded. This deep, nearly level, somewhat poorly drained soil is in long, narrow areas on flood plains. It is subject to frequent flooding. Most areas range from 5 to 25 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsoil is about 37 inches thick. The upper part is dark grayish brown and brown, mottled, friable silty clay loam; and the lower part is grayish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is gray, firm silty clay loam. In places the substratum is stratified silt, sand, and gravel. A few areas are better drained and are less gray in the subsoil.

Included with this soil in mapping are small areas of Genesee, Rawson, and Wabasha soils. The very poorly drained Wabasha soils are in depressions, and the well drained Genesee soils are on slight rises on the flood plains. The moderately well drained and well drained Rawson soils are on slight rises on terraces. These inclusions make up about 15 percent of most areas.

Permeability of this Shoals soil is moderate. The available water capacity is high. Runoff is very slow. The seasonal high water table is at a depth of 12 to 36 inches in winter and spring and in other extended wet periods. The subsoil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part. The organic matter content is moderate. The root zone is deep.

Most of the acreage of this soil is cropland and permanent pasture. Drained areas are suited to corn and soybeans but poorly suited to winter wheat. The main management concerns are frequent flooding and seasonal wetness. They delay planting in most years and limit the choice of crops. Levees may be built to reduce the flood damage. Flood levels can also be reduced by keeping existing channels free of logs and other debris. Most of the acreage has been drained by surface and subsurface drains. The surface layer has a tendency to crust after hard rains. Returning crop residue to the soil, using conservation tillage that leaves crop residue on the soil surface, and planting cover crops improve tilth, reduce crusting, and protect the surface from scouring during floods. Tilling, harvesting, or grazing when the soil is wet causes compaction.

This soil is well suited to woodland. Species selected for planting should be tolerant of some wetness and should be able to withstand flooding. Plant competition can be reduced by spraying, mowing, or disking.

This soil is generally not suited as a site for buildings and septic tank absorption fields because it is frequently flooded. It can be used for recreation, for example, hiking trails, during the drier part of the year.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

To—Toledo silty clay. This deep, nearly level, very poorly drained soil is on broad flats and in long, narrow concave areas on lake plains. It is subject to ponding of short duration (fig. 6). Most areas range from 5 to more than 100 acres. Slope is 0 to 2 percent.

Figure 6.—Areas of Toledo silty clay are subject to ponding.

Typically, the surface layer is very dark grayish brown, firm silty clay about 7 inches thick. The subsoil is dark gray and gray, mottled, firm silty clay about 41 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, mottled, firm silty clay. In some areas the surface layer is lighter colored, and in other areas it contains more sand. In places the subsoil has less clay.

Included with this soil in mapping are small areas of somewhat poorly drained Nappanee and Haskins soils on low knolls and side slopes along drainageways. These inclusions make up about 10 percent of most areas.

Permeability of this Toleos soil is slow. The available water capacity is moderate. Runoff is very slow or ponded. This soil has a seasonal high water table near or above the surface in winter and in spring and in other extended wet periods. The subsoil is slightly acid or neutral. The organic matter content is high. The root zone is deep.

Most of the acreage of this soil is cropland. Corn, soybeans, and small grains are the principal crops. Specialty crops are also grown in some areas. Drained areas are suited to crops, and most of the acreage has been drained. Subsurface drains are commonly used to lower the seasonal high water table where outlets are available. Open ditches and surface drains are used to remove excess surface water. This soil is sticky and plastic when wet. This soil should be tilled, harvested, and grazed within a narrow range of moisture content, because it becomes compacted and cloddy if worked when wet. Planting cover crops and returning crop residue to the soil improve tilth and increase water infiltration.

This soil is suited to woodland. Planting and harvesting can be performed during the drier part of the year. Species selected for planting should be tolerant of wetness and of a clayey surface layer and subsoil in order to reduce the seedling mortality and windthrow hazard.

This soil is poorly suited as a site for buildings. Building sites should be landscaped for good surface drainage away from foundations. Backfilling along foundations with a material low in shrink-swell potential and using drains at the base of footings reduce damage from shrinking and swelling and help prevent wet basements. Exterior basement wall coatings also help prevent wet basements. Local roads and streets can be improved by using suitable base material and providing artificial drainage to reduce damage from low soil strength, ponding, and frost action.

This soil is in capability subclass IIIw and woodland suitability subclass 3w.

Tp—Toledo silty clay, ponded. This deep, nearly level, very poorly drained soil is in long, narrow concave areas along drainageways and on broad flats on lake plains. It is subject to ponding of long duration. Most areas range from 5 to more than 100 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, firm silty clay about 6 inches thick. The subsoil is dark gray, mottled, firm silty clay about 35 inches thick. The substratum to a depth of about 60 inches is gray, mottled, firm silty clay. The surface layer is mucky silty clay in some areas. In places the surface layer is thicker, and in some areas it is lighter colored.

Included with this soil in mapping are small areas of somewhat poorly drained Nappanee soils on slight rises. These inclusions make up 5 to 10 percent of most areas.

Permeability of this Toledo soil is slow. The seasonal high water table is above or near the surface most of the year. The rooting depth is influenced by the water table. This soil has a moderate available water capacity. The subsoil is slightly acid or neutral. Runoff is very slow and ponds on this soil. The organic matter content is high. The root zone is deep.

Some areas of this soil are farmed. Undrained areas are generally not suited to crops; however, drained areas are suited to corn and soybeans. Levees, open ditches, subsurface and surface drains, and pump drainage are commonly used in farming areas. This soil is plastic and sticky when wet. Tilling or harvesting within a narrow range of moisture content is important, because the soil becomes compacted and cloddy if worked when wet.

Most of the acreage of this soil is used for wildlife refuges or hunting preserves. It is generally not suited to woodland. This soil provides excellent habitat for wetland wildlife, because in large areas the water level is controlled by levees and pump drainage. These drainage practices and drainage ditches and surface and subsurface drains permit the growing of grain crops and the flooding of these areas to attract and feed wetland waterfowl during migration.

This soil is generally not suited as a site for buildings and septic tank absorption fields because of ponding, high shrink-swell potential, and slow permeability.

This soil is in capability subclass IVw and is not assigned to a woodland suitability subclass.

Ud—Udorthents, gently sloping. These deep, nearly level and gently sloping soils are in cut and fill areas. Earthmoving and grading have obliterated or mixed the original surface layer, subsoil, and substratum. The remaining soil material typically is similar to the subsoil and substratum of adjacent soils. Slope ranges from 1 to 6 percent.

Typically, the upper 60 inches is firm and dense silty clay loam, clay, or silt loam. In fill or disposal areas, the characteristics of the soils are more variable.

Included with these soils in mapping are small areas where slopes are 6 to 15 percent.

Runoff is medium or rapid. The available water capacity is variable but is dominantly low or very low.

Tilth is poor. Hard rains seal the surface in poorly vegetated areas. A seasonal high water table occurs in depressed or bowl-shaped areas. The organic matter content is very low. The root zone is slightly acid to mildly alkaline.

About half the areas have no vegetative cover. Erosion is a severe hazard in these areas. Controlling erosion, improving fertility and drainage, and selecting adapted plant species are concerns of management. Seeding to adapted grasses and legumes that provide ground cover reduces soil loss by erosion. Many areas should be blanketed with topsoil to improve the root zone. Mulching of seedings helps retain moisture in the soil and increases plant growth.

The suitability of these soils as sites for buildings depends on how long the soil materials have been in place and on such soil characteristics as compaction, permeability, and texture. They are generally not suited to septic tank absorption fields. Onsite investigations are needed to determine the suitability of these soils for a specific land use.

These soils are not assigned to a capability subclass or woodland suitability subclass.

Wa—Wabasha silty clay, frequently flooded. This deep, nearly level, very poorly drained soil is on flood plains. It is in long, narrow areas along small streams with a low gradient, and it is subject to frequent flooding. Most areas range from 5 to 50 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark grayish brown, friable silty clay about 9 inches thick. The subsurface layer is very dark grayish brown, mottled, firm silty clay. The subsoil is grayish brown, mottled, firm silty clay about 30 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, firm silty clay loam. A thinner dark colored surface layer is in a few areas. In some areas less clay is in the subsoil.

Included in mapping are small areas of Shoals, Nappanee, and Hoytville soils and areas that have a silt loam surface layer. The somewhat poorly drained Shoals soils are in slightly higher positions on flood plains. The somewhat poorly drained Nappanee soils are on slope breaks to lake plains. The very poorly drained Hoytville soils are in depressions on lake plains. These inclusions make up 10 to 15 percent of most areas.

Permeability of this Wabasha soil is slow. The available water capacity is moderate or high. Runoff is very slow. The seasonal high water table is near the surface in winter and spring and in other extended wet periods. The subsoil is neutral in the upper part and neutral or mildly alkaline in the lower part. Organic matter content is high. The root zone is deep.

Many areas of this soil are cropland. Corn, soybeans, and small grains are the principal crops. Frequent flooding and seasonal wetness are concerns of management. They delay planting and limit the choice of crops. Flooding often damages winter grain crops. Most areas have been drained and are suited to corn and soybeans. Subsurface drains are commonly used to lower the water table in areas with good outlets. Open ditches are used to remove excess surface water. This soil should be tilled, harvested, and grazed within a narrow range of moisture content because it becomes compacted and cloddy if worked when wet. Compaction interferes with seedling emergence and plant growth. Planting cover crops and returning crop residue to the soil improve tilth, increase water infiltration, and protect the surface from scouring during floods.

This soil is suited to woodland. Many areas of this soil are used for trees. Planting and harvesting can generally be done during the drier part of the year. Selecting species for planting that are tolerant of wetness and of a clayey surface layer and subsoil reduces the windthrow hazard and seedling mortality.

This soil is generally not suited as a site for buildings and septic tank absorption fields because it is flooded frequently and is seasonally wet.

This soil is in capability subclass IIIw and woodland suitability subclass 3w.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

prime farmland

Prime farmland is one of several kinds of important farmlands defined by the U. S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland is defined as the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to produce a sustained high yield of crops when it is treated and managed using acceptable farming methods. These high yields are produced with minimal expenditure of energy and economic resources, and farming this land results in the least damage to the environment.

Prime farmland may now be cropland, pasture, woodland, or anything other than urban or built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity of the soil is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More information on the criteria for prime farmland can be obtained at the local office of the Soil Conservation Service.

About 131,502 acres, or nearly 76 percent of Ottawa County, meets the soil requirements for prime farmland. Most areas of the county are prime farmland except the Castalia-Milton and Toledo associations on the general soil map. Approximately 98,000 acres of this prime farmland is used for crops. Crops grown on this land, mainly corn and soybeans, account for an estimated three-fourths of the county's total agricultural income each year, and truck crops make up most of the rest.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which are farmed although they generally are wetter, or more droughty or erodible, and usually less productive.

The map units that make up prime farmland in Ottawa County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units."

Soils that have limitations, such as a high water table, may qualify for prime farmland if these limitations are overcome by such methods as drainage. In the following list, the method needed to overcome the wetness limitation is shown in parentheses after the map unit name. Onsite evaluation is necessary to see if this limitation has been overcome by corrective measures.

The map units that meet the soil requirements for prime farmland are as follows.

Bo	Bono silty clay (where drained)
Co	Colwood loam (where drained)
DeA	Del Rey silt loam, 1 to 3 percent slopes (where drained)
DuB	Dunbridge fine sandy loam, 2 to 6 percent slopes
HaA	Haskins loam, 0 to 3 percent slopes (where drained)
Hy	Hoytville silty clay loam (where drained)
KfA	Kibbie fine sandy loam, 0 to 2 percent slopes
Lc	Latty silty clay (where drained)
Lf	Lenawee silty clay loam (where drained)
Mh	Millsdale silty clay loam (where drained)
MtB	Milton silt loam, 2 to 6 percent slopes
NpA	Nappanee silty clay loam, 0 to 3 percent slopes (where drained)
RaB	Rawson loam, 2 to 6 percent slopes
To	Toledo silty clay (where drained)

crops and pasture

M. J. Heberling, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1974, there was 112,752 acres of farmland in the county and 98,517 acres of cropland. The principal crops were soybeans, corn, winter wheat, and hay. Smaller acreages were used for tomatoes, sugar beets, cabbage, cucumbers for pickles, other truck crops, orchards, and vineyards.

field crops

The different kinds of soils of Ottawa County vary in their suitability for specific crops, and they require widely different management. Some basic management, however, is needed on practically all of the soils. These basic practices are maintaining an adequate level of fertility, improving drainage, controlling soil loss by water or wind, using good tillage methods, and timely tillage.

Soil fertility is naturally low where the surface layer and subsoil are sandy and naturally high where they are clayey. About three-fourths of the soils are nearly neutral in the surface layer and subsoil. The sandy Algansee and Oakville soils retain only small amounts of plant nutrients. On these soils, applications of lime and fertilizer are needed more often. These applications should be based on the results of soil tests, on crop needs, and on the yield level desired. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply. The current "Agronomy Guide" gives fertilizer recommendations (*8*).

Soil drainage is the major management need on about 98 percent of the cropland in the survey area (*9*). Crops grow well, however, on very poorly drained and somewhat poorly drained soils if excess water is removed by subsurface drains, surface drains, or by a combination of these. Drop structures are commonly used to reduce erosion where surface water enters open ditches. In some areas without suitable outlets for subsurface drains, diking and a pump drainage system are used. Where artificial drainage systems have not been installed on very poorly drained soils, ponding and excess soil moisture in the root zone slow the growth of crops. If soils are not adequately drained, they dry out and warm up slowly, delaying tillage and planting.

The design of both surface and subsurface drains varies with the kind of soil. Surface drains are generally most effective where the subsoil is clayey. The slow or very slow permeability in these soils allows a greater volume of surface water to run off before it enters the soil.

Subsurface drains remove excess water from within the soil. The efficiency of these drains depends on soil permeability and the availability of good outlets. The effectiveness of subsurface drains decreases as internal water movement decreases. Water removal through subsurface drains is most effective in Colwood, Kibbie, Glendora, and Haskins soils. Internal drainage is the slowest in the Bono, Toledo, Hoytville, Latty, and Nappanee soils, which have a clayey subsoil. Subsurface drains must be closely spaced in these soils for uniform drainage. Although thousands of acres have been artificially drained in Ottawa County, many fields and farms remain inadequately drained. An added problem in soils that have a sandy subsoil and in Kibbie soils is the filling of subsurface drains with silts and very fine sands. These materials flow when saturated and will block subsurface drains unless drains are protected.

Erosion control practices should be used on much of the cropland in the county. Even on the Hoytville, Toledo, and Latty soils on broad flats, crop residue should be left on the surface to reduce soil loss by erosion. Common erosion control is often related to drainage. For example, even the flatter soils are often visibly eroded along ditchbanks and streams. Two important erosion control practices in Ottawa County are seeding ditchbanks and establishing sod berms along drainageways. In areas where concentrated surface water enters drainageways, erosion or water control structures should be installed if sod berms are not effective. Surface and subsurface drainage systems are used to route water safely to outlet ditches or streams with minimum erosion and without affecting water quality. The quality of Lake Erie water is especially affected by erosion in the watershed.

Control of water erosion is especially needed in soils that have slopes of more than 2 percent. Grassed waterways are needed to prevent erosion in more rolling terrain and to prevent gully formation in the steeper areas. On more sloping soils, the use of reduced tillage systems or conservation tillage that leaves crop residue on the soil surface reduces erosion. Conservation tillage commonly saves energy and improves soil tilth. Loss of even part of the surface layer from, for example, the St. Clair soils results in mixing of the heavier textured subsoil with the plow layer during tillage. As a result, the finer textured surface layer has poorer tilth.

Soil blowing is a hazard on the sandy soils and some of the soils with a loamy surface layer. Soil blowing can damage young plants, especially vegetables, very quickly and can damage these soils in just a few hours. Soil blowing is especially a hazard on dry soils without a cover of vegetation or mulch. It can be controlled by maintaining a cover of good vegetative crop residue or mulch. Soil blowing can also be reduced by leaving rough surfaces and establishing windbreaks. Algansee, Glendora, Kibbie, Oakville, and Rimer soils are most affected by soil blowing.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide available in the local office of the Soil Conservation Service.

Soil tilth is an important factor in germination of seeds and in the infiltration of water and air into the soil. Soils that have good tilth are granular and porous.

The texture of the surface layer of the soils in Ottawa County ranges from fine sand to silty clay. For planning tillage, all of the mineral soils can be placed into groups which are discussed in the following paragraphs.

Soil tilth is easily degraded if the soils are worked when they are wet. The incorporation of organic matter improves soil tilth. Planting cover crops and returning crop residue to the soil or using grasses and legumes in the cropping system helps to maintain or improve soil tilth. Conservation tillage that leaves crop residue on the soil surface commonly improves soil tilth, increases the organic matter content, and reduces compaction.

Castalia, Kibbie, Glendora, Oakville, Rimer, and Algansee soils have a fine sandy loam or coarser than fine sandy loam surface layer. These soils can be tilled safely throughout a wide range in moisture content.

Colwood, Genesee, Milton, Rawson, Genesee Variant, Haskins, and Shoals soils have a loam or silt loam surface layer. These soils have a narrower range of optimum moisture for tillage than the soils that have a sandy loam or coarser textured surface layer. Also, they tend to dry more slowly than the coarser textured soils. If these soils are cultivated within the range of optimum moisture, harmful effects on the soil structure are few and of short duration.

Bono, Hoytville, Latty, Lenawee, Millsdale, Nappanee, St. Clair, Toledo, and Wabasha soils have a silty clay loam or finer surface layer. These soils have the narrowest range of optimum moisture for tillage. The clay content in the surface layer is generally high enough to cause serious clodding and/or sealing if the soils are tilled when wet.

Pasture and hay are minor land uses in Ottawa County. Some alfalfa is grown for alfalfa meal. Most areas of pasture are on soils that have potential for crops. Some areas used for pasture are on sloping or frequently flooded soils. The sloping soils are subject to erosion and commonly have poor tilth. Most soils used for pasture require drainage. Soils that require drainage for maximum growth of row crops also require drainage for maximum growth of pasture plants. Other important practices in managing pasture are erosion control, addition of lime and fertilizer, reducing compaction, and brush control. On sandy soils, the maintenance of plant population is a management concern.

special crops

Special crops grown for commercial use in Ottawa County include nursery stock, orchards, vineyards, and vegetables. No attempt will be made in this section to give specific practices, fertilization rates, or seed varieties for these crops. A high level of management is needed to successfully produce these crops. More complete information can be obtained on crop management from the local offices of the Cooperative Extension Service and on soil and water management from the Soil Conservation Service.

The investment in labor and machinery and other costs are generally higher for special crops than for general farm crops. The high value of the special crops makes the use of good soil management and cultural practices a necessity.

Most of the nursery stock produced in Ottawa County is grown on the loamy Rawson and Haskins soils. These soils have a good root zone and are easy to till and plant.

Many of the orchards and vineyards are on soils where the bedrock is near the surface. These areas are mainly on the islands and the peninsula. Grape vineyards are dominant on Milton, Rawson, and Dunbridge soils of the North and Middle Bass Islands. Some apple and peach orchards are planted throughout the county on

Toledo and Nappanee soils. The expanding urbanization of Catawba and South Bass Islands is reducing the acreage in orchards and vineyards.

Sugar beets, tomatoes, cabbage, and cucumbers are important special crops grown in the county. They are well suited to drained areas of Hoytville, Lenawee, Toledo, Colwood, Kibbie, and Rimer soils. These special crops were traditionally grown in drained areas of fine textured soils that are naturally very poorly drained, where root growth and diseases are concerns. As new varieties become available, they are grown on a wider range of soils. Although drainage is one of the most important concerns, soil compaction is also important.

Other important specialty crops grown in the county are fresh vegetables for roadside stands. These crops are grown on a variety of soils, but mainly on coarse textured soils which dry out and warm up earlier in spring. Cutting of tender plants by blowing sand is a major concern on these soils until the vegetation is high enough to reduce the effect of wind velocity.

Irrigation

Rainfall in Ottawa County is generally adequate for most crops, but it is not always timely or well distributed. Extended dry periods sometimes occur between May and September.

Irrigated acreage has been increasing in the past few years as methods of irrigation become more economical. Water from Lake Erie and Portage River is utilized for irrigation.

Many soils in the county are suited to irrigation and can be profitably irrigated. Features that affect the suitability of a soil for irrigation are water-holding capacity, slope, water-intake rate, and drainage. Clayey and loamy soils, which have a higher water-holding capacity and usually a slower intake rate, are better suited to irrigation than sandy soils.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey (*13*). These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

Nearly all of Ottawa County was forest at the time of settlement. Much of the central and western part of the county was in the Great Black Swamp, which mostly supported a heavy forest growth in which elm was very important. The woodland of this part of the county is classified into two main groups, the elm-ash swamp forest and the oak-sugar maple forest (*4*). The elm-ash swamp forest was in the flat, low-lying areas. It included American elm and slippery elm, black ash, silver maple, pin oak, swamp white oak, American sycamore, and blackgum, and in the slightly better drained areas, bur oak, white oak, and shellbark hickory. The oak-sugar maple forest was in slightly elevated areas and was made up mainly of American beech, sugar maple, yellow-poplar, black walnut, northern red oak, black oak, and bitternut hickory.

The woodland in the eastern part of the county, including Catawba Island and Marblehead Peninsula, was variable. The natural vegetation consisted of elm-ash swamp forest, which had species similar to those in the central and western parts of the county, and mixed oak forest of mainly black maple, black walnut, sugar maple, slippery elm, blue ash, and bitternut hickory.

As a result of clearing, the woodland in the county has been reduced to about 5,000 acres. Most of the remaining wooded areas are small farm woodlots. Most of the woodland has been cut over, and much of it has been harmfully grazed.

Compared to the returns from the sale of other farm products, income from the sale of wood products is small. Some good quality logs of oak and black walnut are cut from the better managed woodland. Also, farm woodlots provide wood for fuel, lumber for rough construction, and edible nuts.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

windbreaks and environmental plantings

Farmstead and feedlot windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, Ohio Department of Natural Resources, Division of Forestry, or the Cooperative Extension Service or from a nursery.

recreation

Lake Erie is the center of much of the recreation in Ottawa County. Swimming, boating, and fishing attract thousands throughout the summer months. Ice fishing is a popular pastime in winter months. The main resorts on Lake Erie are on Catawba Island, Marblehead Peninsula, and South Bass Islands. The principal soils in these areas are the Castalia, Milton, Dunbridge, Oakville, Algansee, and Nappanee soils.

The cities and townships in Ottawa County have parks equipped with baseball diamonds, tennis courts, and playground equipment. Tourists are attracted to a large number of private and commercial recreation areas, including campgrounds and golf courses.

Special events include the national rifle and pistol matches held at Camp Perry and the annual inter-lake regatta at Put-in-Bay. On Marblehead Peninsula, Lakeside has one of the largest summer conference grounds in the Middle West and is known as "The Chautauqua of the Great Lakes." Hoover Auditorium features the top attractions of the entertainment world as well as concerts, drama, opera, and noted lecturers.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

M. J. Heberling, district conservationist, Soil Conservation Service, helped prepare this section.

Ottawa County has many upland and wetland acres which can be managed for wildlife habitat. With more intensive cropping, fall plowing, and increased urbanization, wildlife populations decreased. Whether land is managed with wildlife as a primary or a secondary consideration, habitat improvements can be made that will greatly benefit wildlife. For example, grass and legumes can be planted in field borders and along drainageways or woody plants in clumps or hedgerows. Such plantings can be very successful in attracting wildlife even if primarily geared toward another use such as cropland.

Ottawa County has the largest acreage of wetlands remaining in the state of Ohio. Located in the flight path of both the Mississippi and Atlantic flyways, there is much opportunity for wetland habitat development. Canada geese and ducks, especially mallards, black ducks, teal, and wood ducks, make up the majority of waterfowl using the county's wetlands. In order to attract waterfowl, habitat development can be directed toward fall resting and feeding needs. More complete waterfowl habitat can also be developed to encourage nesting and to meet nearly year-round waterfowl needs.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, timothy, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, smartweed, ragweed, and fescue.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, beech, maple, hawthorn, dogwood, hickory, and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are shrub honeysuckle, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are duckweed, wild millet, reed canarygrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other such structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of these areas are marshes, waterfowl feeding areas, and shallow ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, and mink.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment.

Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains as much as 15 or 20 percent of particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

physical and chemical analyses of selected soils

Some of the soils in Ottawa County were sampled and laboratory data determined by the Soil Characterization Laboratory, Department of Agronomy, Ohio State University, Columbus, Ohio. The physical and chemical data obtained on most samples include particle size distribution, reaction, organic-matter content, calcium carbonate equivalent, and extractable cations.

These data were used in classifying and correlating the selected soils and in evaluating the behavior of the soils under various land uses. Five of the profiles were selected as representative of their respective series and are described in this survey. The series names and the laboratory identification numbers are Bono (OT-5), Colwood (OT-9), Millsdale (OT-7), Toledo (OT-6), and Wabasha (OT-8).

In addition to Ottawa County data, laboratory data are also available from nearby counties that have many of the same soils. All data are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; and the Soil Conservation Service, State office, Columbus, Ohio.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*14*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aqualf (*Aqu*, meaning water, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ochraqualfs (*Ochr*, meaning light colored surface layer, plus *aqualf*, the suborder of the Alfisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aeric* identifies the subgroup that is dryer than the typical great group. An example is Aeric Ochraqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, illitic, mesic Aeric Ochraqualfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*12*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*14*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Algansee series

The Algansee series consists of deep, somewhat poorly drained, very rapidly permeable soils formed in sandy deposits on beaches. Slope is 0 to 2 percent.

These soils have a thicker dark-colored surface layer than is definitive for the Algansee series. This difference, however, does not alter the usefulness or behavior of the soils.

Algansee soils are commonly adjacent to Glendora and Oakville soils. Glendora soils are very poorly drained and are in depressions. They are grayer in the upper part of the substratum than Algansee soils. Oakville soils are well drained and are on the tops and shoulders of the beach ridges. They are not gray in the subsoil and the upper part of the substratum.

Typical pedon of Algansee fine sand, occasionally flooded, about 8 miles northeast of Port Clinton, Danbury Township, East Harbor State Park, and 1,485 feet southeast along Beach Rd. from the intersection of Beach Rd. and Park Causeway, then 30 feet west.

A1—0 to 5 inches; black (10YR 2/1) fine sand, very dark gray (10YR 3/1) dry; single grained; loose; common roots; neutral; clear smooth boundary.

A2—5 to 14 inches; very dark gray (10YR 3/1) fine sand, very dark gray (10YR 3/1) dry; single grained; loose; few roots; neutral; abrupt wavy boundary.

C1—14 to 27 inches; brown (10YR 4/3) fine sand; common coarse distinct grayish brown (10YR 5/2) mottles; single grained; loose; very dark gray (10YR 3/1) fillings in old root channels; neutral; clear smooth boundary.

C2—27 to 60 inches; dark yellowish brown (10YR 4/4) fine sand; common medium distinct yellowish brown (10YR 5/8) and grayish brown (10YR 5/2) mottles; single grained; loose; very dark gray (10YR 3/1) fillings in old root channels; slight effervescence; mildly alkaline.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is fine sandy or loamy fine sand. Some pedons have thin layers with fine gravel.

Bono series

The Bono series consists of deep, very poorly drained, slowly or very slowly permeable soils formed in glacial lakebed sediments on lake plains. Slope is 0 to 2 percent.

These soils have mixed mineralogy rather than illitic as is defined as typical for the Bono series elsewhere. This difference, however, does not alter the usefulness or behavior of the soils.

Bono soils are commonly adjacent to Latty, Nappanee, and Toledo soils and are similar to Latty and Toledo soils. Latty and Nappanee soils have an ochric epipedon. Latty and Toledo soils are similar in position on the landscape to Bono soils. Nappanee soils are somewhat poorly drained and are less gray in the subsoil than Bono soils. They are on slight rises and slopes along waterways. Toledo soils do not have as thick a dark-colored surface layer.

Typical pedon of Bono silty clay, 3.5 miles southwest of Port Clinton, Bay Township, 1,360 feet east and 129 feet north of the southwest corner of sec. 10, T. 6 N., R. 16 E.

Ap—0 to 7 inches; black (5Y 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; firm; many roots; neutral; clear smooth boundary.

A—7 to 14 inches; very dark gray (5Y 3/1) silty clay, dark gray (10YR 4/1) dry; common medium prominent yellowish brown (10YR 5/4) mottles; weak medium and fine subangular blocky structure; firm; many roots; black (5Y 2/1) organic stains; neutral; abrupt smooth boundary.

Bg—14 to 27 inches; gray (5Y 5/1) silty clay; many medium distinct light olive brown (2.5Y 5/4 and 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; very firm; common roots; black (10YR 2/1) organic stains; neutral; abrupt smooth boundary.

BCg—27 to 45 inches; gray (5Y 5/1) silty clay; many coarse distinct dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure parting to weak medium angular blocky; very firm; few roots; common medium black (10YR 2/1) stains (iron and manganese oxides); few medium light gray (10YR 7/2) lime deposits on faces of peds; slight effervescence; mildly alkaline; diffuse smooth boundary.

Cg—45 to 60 inches; gray (5Y 5/1) silty clay; common coarse prominent dark brown (7.5YR 4/4) mottles; massive; very firm; few medium gray (10YR 7/2) lime deposits on vertical faces of peds; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 30 to 55 inches. Thickness of the mollic epipedon ranges from 10 to 16 inches. The reaction is slightly acid or neutral in the upper part of the solum and mildly alkaline or moderately alkaline in the lower part.

The mollic epipedon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1 or 2. The B and BC horizons below the mollic epipedon have hue of 10YR to 5Y, value of 4 or 5, and chroma of 0 to 2. They are silty clay or clay. The C horizon has hue of 10YR to 5Y or is neutral, value of 4 or 5, and chroma of 1 or 2. The C horizon is silty clay, clay, or heavy silty clay loam.

Castalia series

The Castalia series consists of moderately deep and well drained soils. These soils formed in fractured limestone and in glacial drift in voids in bedrock on knolls and slight rises. Permeability is rapid. Slope ranges from 1 to 6 percent.

Castalia soils are commonly adjacent to Dunbridge, Millsdale, Milton, and Rawson soils. Dunbridge, Millsdale, Milton, and Rawson soils have fewer rock fragments throughout the soil. The very poorly drained Millsdale soils are in depressions and on flats. Rawson soils are deep to bedrock.

Typical pedon of Castalia very stony fine sandy loam, 1 to 6 percent slopes, about 1 mile southwest of Genoa, Clay Township, 225 feet north and 800 feet east of the southwest corner of sec. 4, T. 6 N., R. 13 E.

A—0 to 7 inches; black (10YR 2/1) very stony fine sandy loam, very dark gray (10YR 3/1) dry; strong fine granular structure; very friable; many roots; 25 percent rock fragments about 15 percent more than 10 inches in diameter; rock fragments have slight effervescence; mildly alkaline; abrupt wavy boundary.

Bw—7 to 14 inches; reddish brown (5YR 4/3) very channery loam; weak medium granular structure; very friable; many roots; black (10YR 2/1) fillings in old root channels; about 60 percent rock fragments; rock fragments have slight effervescence; mildly alkaline; clear wavy boundary.

BC—14 to 20 inches; reddish brown (5YR 4/4) extremely channery sandy loam; very weak medium subangular blocky structure; very friable; many roots; black (10YR 2/1) fillings in old root channels; about 70 percent rock fragments; rock fragments have slight effervescence; moderately alkaline; clear wavy boundary.

C—20 to 27 inches; yellowish red (5YR 4/6) extremely flaggy loamy sand; single grained; loose; many roots; black (10YR 2/1) fillings in old root channels; about 85 percent rock fragments, soil material is between rock fragments; rock fragments have slight effervescence; moderately alkaline; diffuse irregular boundary.

R—27 inches; dolomitic limestone with fractures 3 to 6 feet apart.

Thickness of the solum ranges from 20 to 40 inches. The soil is mildly alkaline or moderately alkaline throughout. The mollic epipedon ranges from 7 to 9 inches thick.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B and BC horizons have hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 to 6. Texture of the fine earth is sandy loam or loam. The C horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 6. Texture of the fine earth is sandy loam, loamy sand, or loam.

Colwood series

The Colwood series consists of deep, very poorly drained, moderately permeable soils formed in stratified loamy and sandy glacial lakebed sediments on lake plains. Slope is 0 to 2 percent.

These soils have less clay in the B2 horizon than is definitive for the Colwood series. This difference, however, does not alter the usefulness or behavior of the soils.

Colwood soils are commonly adjacent to Del Rey, Haskins, Kibbie, Lenawee, and Rimer soils and similar to Lenawee soils. Del Rey, Haskins, Kibbie, and Rimer soils are somewhat poorly drained, are on slight rises, and are less gray in the subsoil than Colwood soils. Del Rey and Haskins soils have an ochric epipedon. Lenawee soils have more clay in the subsoil.

Typical pedon of Colwood loam, about 0.75 mile north of Elmore, Harris Township, 78 feet east and 990 feet south of the northwest corner of sec. 18, T. 6 N., R. 14 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate medium and fine granular structure; very friable; many roots; neutral; clear wavy boundary.

Bg1—11 to 16 inches; grayish brown (10YR 5/2) loam; common medium faint gray (10YR 5/1) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common roots; very dark grayish brown (10YR 3/2) organic coatings; neutral; clear smooth boundary.

Bg2—16 to 23 inches; grayish brown (10YR 5/2) loam; common medium distinct yellowish brown (10YR 5/6) and few medium faint gray (10YR 5/1) mottles; weak medium and fine subangular blocky structure; friable; common roots; thin patchy grayish brown (10YR 5/2) coatings on vertical faces of peds; very dark grayish brown (10YR 3/2) organic stains; neutral; clear smooth boundary.

Bg3—23 to 30 inches; grayish brown (10YR 5/2) stratified loam and sandy loam; common coarse distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; common roots; dark grayish brown (10YR 4/2) fillings in old root channels; thin patchy grayish brown (10YR 5/2) coatings on faces of peds; neutral; clear smooth boundary.

BCg—30 to 38 inches; gray (10YR 5/1) stratified very fine sandy loam, clay loam, and sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; few roots; neutral; clear smooth boundary.

Cg1—38 to 50 inches; dark grayish brown (10YR 4/2) loam; common medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; slight effervescence; mildly alkaline; diffuse smooth boundary.

Cg2—50 to 60 inches; dark grayish brown (10YR 4/2) silt loam; common medium and coarse distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; slight effervescence; mildly alkaline.

Thickness of the solum ranges from 30 to 45 inches. Thickness of the mollic epipedon ranges from 10 to 12 inches. The solum is slightly acid or neutral.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B and BC horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. They are loam, sandy loam, clay loam, very fine sandy loam, fine sandy loam, silty clay loam, or silt loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is loam, fine sandy loam, or silt loam. Thin strata of loamy sand are in many pedons.

Del Rey series

The Del Rey series consists of deep, somewhat poorly drained, slowly permeable soils formed in glacial lakebed sediments on lake plains. Slope ranges from 1 to 3 percent.

Del Rey soils are commonly adjacent to Haskins, Kibbie, Lenawee, and Rimer soils and are similar to Haskins and Nappanee soils. Haskins, Kibbie, and Rimer soils have more sand and less silt in the upper and middle parts of the subsoil than Del Rey soils. Lenawee soils are very poorly drained and are grayer in the subsoil. They are on flats and in depressions. Nappanee soils have more clay in the subsoil and substratum.

Typical pedon of Del Rey silt loam, 1 to 3 percent slopes, about 2.5 miles northeast of Elmore, Harris Township, 400 feet east and 1,900 feet north of the southwest corner of sec. 9, T. 6 N., R. 14 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium and fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

Bt1—9 to 17 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; many roots; dark gray (10YR 4/1) continuous coatings and thin patchy clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—17 to 23 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; many roots; dark gray (10YR 4/1) continuous coatings and thin continuous clay films on faces of peds; common fine very dark gray (10YR 3/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Bt3—23 to 27 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; common roots; dark gray (10YR 4/1) continuous coatings and thin patchy clay films on faces of peds; common fine distinct very dark gray (10YR 3/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Bt4—27 to 36 inches; brown (10YR 4/3) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common roots; dark gray (10YR 4/1) continuous coatings and thin very patchy clay films on faces of peds; neutral; clear smooth boundary.

BC—36 to 45 inches; brown (10YR 4/3) silty clay loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few roots; slight effervescence; mildly alkaline; clear smooth boundary.

C—45 to 60 inches; brown (10YR 4/3) silty clay loam; few fine distinct yellowish brown (10YR 5/4) mottles; massive; firm; common light gray (10YR 7/2) lime deposits; 1 inch strata of grayish brown (10YR 5/2) fine sand; strong effervescence; moderately alkaline.

Thickness of the solum and depth to free carbonates range from 26 to 45 inches.

The Ap horizon is commonly silt loam, but is silty clay loam in some pedons. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly silty clay loam and has thin bands of silt loam in some pedons. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is commonly silty clay loam and has thin bands of sandy loam in some pedons.

Dunbridge series

The Dunbridge series consists of moderately deep, well drained soils formed in glacial outwash over limestone bedrock. Permeability is moderately rapid. Slope ranges from 2 to 6 percent.

Dunbridge soils are commonly adjacent to Castalia, Haskins, Milton, Nappanee, and Rawson soils. Castalia soils contain more coarse fragments throughout the soil than Dunbridge soils and have a cambic horizon. Haskins, Nappanee, and Rawson soils are deep to bedrock and have a lighter colored surface layer. Haskins and Nappanee soils are somewhat poorly drained and have gray mottles in the subsoil. They are on flats and slight rises. Milton soils have a lighter colored surface layer and have more clay and less sand in the subsoil.

Typical pedon of Dunbridge fine sandy loam, 2 to 6 percent slopes, about 7 miles northeast of Port Clinton, Catawba Island Township, 100 feet southwest along Catawba Rd. from the intersection of Catawba and Weyhe Rds., then 1,075 feet east.

Ap—0 to 9 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; moderate medium and fine granular structure; friable; many roots; about 8 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bt1—9 to 13 inches; strong brown (7.5YR 5/6) loam; moderate medium and fine subangular blocky structure; friable; many roots; dark brown (10YR 3/3) fillings in pores; very thin patchy dark brown (7.5YR 4/4) clay films and coatings on faces of peds; about 8 percent coarse fragments; slightly acid; clear smooth boundary.

Bt2—13 to 29 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; common roots; dark brown (10YR 3/3) fillings in pores; thin patchy dark brown (7.5YR 4/4) clay films and coatings on faces of peds; about 8 percent coarse fragments; neutral; clear smooth boundary.

C—29 to 34 inches; strong brown (7.5YR 5/6) gravelly sandy loam; massive; friable; few roots; 20 percent coarse fragments; neutral; abrupt smooth boundary.

2R—34 inches; limestone bedrock with vertical fractures 2 to 4 feet apart.

Thickness of the solum ranges from 20 to 40 inches.

The Ap horizon has hue of 7.5YR or 10YR and value and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR, value or 4 or 5, and chroma of 3 to 6. It is slightly acid in the upper part and neutral or mildly alkaline in the lower part.

Genesee series

The Genesee series consists of deep, well drained, moderately permeable soils formed in recent alluvium on flood plains. Slope is 0 to 2 percent.

Genesee soils are commonly adjacent to Rawson, Shoals, St. Clair, and Wabasha soils and are similar to Genesee Variant soils. Genesee Variant soils are moderately deep to bedrock. Rawson soils are on terraces along streams, and St. Clair soils are on lake plains. These soils have an argillic horizon. Shoals and Wabasha soils are wetter on flood plains than Genesee soils. They are grayer in the subsoil.

Typical pedon of Genesee silt loam, frequently flooded, about 3 miles south-southwest of Rocky Ridge, Harris Township, 90 feet east and 1,480 feet north of the southwest corner of sec. 10, T. 6 N., R. 14 E.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, light brownish gray (10YR 6/3) dry; moderate medium and fine granular structure; friable; many roots; dark brown (10YR 3/3) coatings on faces of peds; slightly acid; abrupt smooth boundary.

C1—7 to 13 inches; brown (10YR 4/3) silt loam; weak medium and fine subangular blocky structure; friable; many roots; very dark grayish brown (10YR 3/2) fillings in worm channels; organic stains on faces of peds; neutral; clear smooth boundary.

C2—13 to 19 inches; brown (10YR 4/3) silt loam; weak medium and fine subangular blocky structure; friable; many roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; dark brown (10YR 3/3) fillings in worm channels; neutral; clear smooth boundary.

C3—19 to 32 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; many roots; dark brown (10YR 3/3) fillings in worm channels; neutral; clear smooth boundary.

C4—32 to 47 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; common roots; common white (10YR 8/2) snail shells; slight effervescence; mildly alkaline; clear smooth boundary.

C5—47 to 60 inches; dark yellowish brown (10YR 4/4) loam; few fine faint brown (10YR 5/3) and few medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few roots; 4 percent pebbles; many white (10YR 8/2) snail shells; strong effervescence; moderately alkaline.

The depth to free carbonates ranges from 30 to 40 inches.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4. The C horizon has hue of 10YR and value and chroma of 3 or 4.

Genesee Variant

The Genesee Variant consists of moderately deep, well drained, moderately permeable soils formed in recent alluvium over limestone bedrock along major streams. Slope is 0 to 2 percent.

Genesee Variant soils are commonly adjacent to Genesee, Rawson, and St. Clair soils and are similar to Genesee soils. Genesee, Rawson, and St. Clair soils are deep to bedrock. Rawson and St. Clair soils have an argillic horizon. Rawson soils are on stream terraces, and St. Clair soils are on lake plains.

Typical pedon of Genesee Variant loam, frequently flooded, about 1.5 miles west of Elmore, Harris Township, 2,145 feet west and 1,400 feet south of the northeast corner of sec. 23, T. 6 N., R. 13 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate fine and medium granular structure; very friable; many roots; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

C1—8 to 18 inches; brown (10YR 5/3) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; many roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

C2—18 to 25 inches; dark brown (7.5YR 4/4) silty clay loam; many fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; common roots; about 2 percent coarse fragments; mildly alkaline; abrupt wavy boundary.
C3—25 to 30 inches; dark brown (7.5YR 4/4) silty clay loam; common medium distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; common roots; 10 percent coarse fragments; slight effervescence; mildly alkaline; abrupt wavy boundary.
2R—30 inches; dolomitic limestone bedrock.

The soil is neutral or mildly alkaline throughout.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or loam in the upper part and silty clay loam or clay loam in the lower part. Rock fragments range from 10 to 60 percent in a thin layer immediately above the bedrock.

Glendora series

The Glendora series consists of deep, very poorly drained, rapidly permeable soils formed in sandy deposits in depressions between beach ridges. Slope is 0 to 2 percent.

Glendora soils are commonly adjacent to Algansee, Nappanee, Oakville, and Toledo soils. Algansee, Nappanee, and Oakville soils are better drained and on slightly higher positions than Glendora soils. They are not dominantly gray immediately beneath the A horizon. Nappanee and Toledo soils are finer textured throughout. Toledo soils are similar in position to Glendora soils.

Typical pedon of Glendora loamy fine sand, frequently flooded, about 11 miles east of Port Clinton, Danbury Township, Bay Point, 3,630 feet northeast along Bay Shore Rd. from the intersection of Bay Shore and Marblehead South Roads, then 7,425 feet south.

A—0 to 7 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; single grained; loose; many roots; neutral; abrupt smooth boundary.
Cg1—7 to 12 inches; dark gray (10YR 4/1) fine sand; common coarse prominent strong brown (7.5YR 5/6) mottles; single grained; loose; common roots; slight effervescence; mildly alkaline; abrupt smooth boundary.
Cg2—12 to 22 inches; grayish brown (10YR 5/2) sand; single grained; loose; 10 percent gravel; few snail shells; strong effervescence; moderately alkaline; abrupt smooth boundary.
Cg3—22 to 60 inches; gray (10YR 5/1) fine sand; single grained; loose; 10 percent gravel; violent effervescence; moderately alkaline.

The A horizon ranges from 4 to 12 inches thick. It has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 0 or 1. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is neutral or mildly alkaline in the upper part and moderately alkaline in the lower part.

Haskins series

The Haskins series consists of deep, somewhat poorly drained soils formed in loamy glacial outwash and in the underlying glacial till or lacustrine material on lake plains and stream terraces. Permeability is moderate in the upper part of the profile and slow or very slow in the lower part. Slope ranges from 0 to 3 percent.

Haskins soils are commonly adjacent to Del Rey, Nappanee, Rawson, Rimer, and Toledo soils and are similar to Del Rey and Nappanee soils. Del Rey, Nappanee, and Toledo soils have less sand and more clay in the upper and middle parts of the subsoil than Haskins soils. Rawson soils are well drained and moderately well drained and are less gray in the subsoil. Rimer soils have more sand and less clay in the upper part of the subsoil. Toledo soils are very poorly drained soils and are grayer in the subsoil. They are on flats.

Typical pedon of Haskins loam, 0 to 3 percent slopes, about 7 miles northeast of Port Clinton, Catawba Island Township, 825 feet east of the intersection of Catawba Woods Drive and Catawba Road.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; moderate medium and fine granular structure; friable; many roots; about 2 percent pebbles; medium acid.
Bt1—7 to 14 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many medium distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; many roots; grayish brown (10YR 5/2) continuous coatings and very thin very patchy clay films on faces of peds; dark grayish brown (10YR 4/2) fillings in old root channels; about 2 percent pebbles; common medium very dark gray (10YR 3/1) stains (iron and manganese oxides); medium acid; clear smooth boundary.
Bt2—14 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct strong brown (7.5YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; many roots; grayish brown (10YR 5/2) continuous coatings and thin patchy clay films on faces of peds; dark grayish brown (10YR 4/2) fillings in old root channels; about 2 percent pebbles; common medium very dark gray (10YR 3/1) stains (iron and manganese oxides); medium acid; clear smooth boundary.

Bt3—24 to 34 inches; yellowish brown (10YR 5/4) clay loam; many medium distinct strong brown (7.5YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; many roots; grayish brown (10YR 5/2) continuous coatings and thin patchy clay films on vertical faces of peds; many medium and coarse very dark gray (10YR 3/1) stains (iron and manganese oxides); about 2 percent pebbles; slightly acid; abrupt smooth boundary.

2BCg—34 to 49 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and brown (7.5YR 5/4) mottles; weak medium platy structure; very firm; light reddish brown (5YR 6/3) secondary lime deposits; mildly alkaline; clear smooth boundary.

2C—49 to 60 inches; brown (10YR 5/3) silty clay loam; common medium distinct yellowish brown (10YR 5/8) and common medium faint grayish brown (10YR 5/2) mottles; massive; very firm; many light reddish brown (5YR 6/3) and light gray (10YR 7/2) secondary lime deposits; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 25 to 30 inches. Thickness of the loamy outwash ranges from 20 to 40 inches.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam, sandy clay loam, or clay loam and the gravelly analogs of these textures. The 2BC horizon is silty clay loam, silty clay, or clay. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is silty clay loam, silty clay, or clay.

Hoytville series

The Hoytville series consists of deep, very poorly drained soils formed in glacial till material modified by water action on lake plains. Permeability is slow. Slope is 0 to 2 percent.

Hoytville soils are commonly adjacent to Latty, Nappanee, and St. Clair soils and similar to Toledo soils. Latty, Nappanee, and St. Clair soils have an ochric epipedon. Latty and Toledo soils formed in glacial lakebed sediments and do not have an argillic horizon or pebbles throughout the soil. Nappanee and St. Clair soils are better drained and are less gray in the subsoil than Hoytville soils. They are on slight rises and side slopes along drainageways.

Typical pedon of Hoytville silty clay loam, about 2.5 miles southwest of Genoa, Clay Township, 890 feet north and 1,980 feet west of the southeast corner of sec. 6, T. 6 N., R. 13 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, gray (10YR 5/1) dry; moderate medium and fine granular structure; friable; many roots; 4 percent coarse fragments; neutral; clear smooth boundary.

Btg1—7 to 11 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; many roots; dark grayish brown (10YR 4/2) coatings on faces of peds; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; very dark grayish brown (10YR 3/2) organic stains; 4 percent coarse fragments; neutral; clear smooth boundary.

Btg2—11 to 17 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; moderate medium and fine angular blocky structure; firm; many roots; dark grayish brown (10YR 4/2) coatings and thin patchy clay films on faces of peds; very dark grayish brown (10YR 3/2) organic stains and fillings in old root channels; 4 percent coarse fragments; common medium black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Btg3—17 to 25 inches; grayish brown (10YR 5/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak medium and fine angular blocky structure; firm; common roots; grayish brown (10YR 5/2) coatings and thin patchy clay films on faces of peds; few very dark gray (10YR 3/1) organic stains; 6 percent coarse fragments; common medium black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Btg4—25 to 33 inches; grayish brown (10YR 5/2) silty clay; many medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; common roots; grayish brown (10YR 5/2) coatings and few very patchy grayish brown (10YR 5/2) clay films on vertical faces of peds; 4 percent coarse fragments; common medium distinct black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

BCg—33 to 46 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; common roots; grayish brown (10YR 5/2) coatings and few very patchy grayish brown (10YR 5/2) clay films on faces of peds; 4 percent coarse fragments; common medium black (10YR 2/1) stains (iron and manganese oxides); slight effervescence; mildly alkaline; abrupt smooth boundary.

C—46 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; massive; very firm; few roots; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 36 to 50 inches. The solum is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is silty clay loam, silty clay, or clay.

Kibbie series

The Kibbie series consists of deep, somewhat poorly drained, moderately permeable soils formed in stratified loamy and sandy glacial lakebed sediments on lake plains. Slope ranges from 0 to 3 percent.

Kibbie soils are commonly adjacent to Colwood, Del Rey, Haskins, Lenawee, and Rimer soils. Colwood and Lenawee soils are very poorly drained and are on broad flats and in depressions. They are grayer in the subsoil than Kibbie soils. Del Rey and Haskins soils have more clay in the lower part of the subsoil. Rimer soils have more sand and less clay in the subsoil. Del Rey, Haskins, and Rimer soils are similar in position to Kibbie soils and have a lighter colored surface layer.

Typical pedon of Kibbie fine sandy loam, 0 to 2 percent slopes, about 0.75 mile north of Elmore, Harris Township, 300 feet east and 1,550 feet south of the northwest corner of sec. 18, T. 6 N., R. 14 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium and fine granular structure; very friable; many roots; neutral; clear wavy boundary.

BA—9 to 17 inches; dark grayish brown (2.5Y 4/2) loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; many roots; very dark gray (10YR 3/1) organic coatings; neutral; abrupt wavy boundary.

Bt1—17 to 25 inches; yellowish brown (10YR 5/4) stratified loam and silty clay loam; many medium faint yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; many roots; dark grayish brown (10YR 4/2) coatings on faces of peds; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; very dark grayish brown (10YR 3/2) organic coatings; neutral; clear smooth boundary.

Bt2—25 to 37 inches; yellowish brown (10YR 5/4) stratified loam and silty clay loam; common coarse distinct gray (10YR 5/1) and common coarse faint yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak medium and fine subangular blocky; very friable; many roots; dark grayish brown (10YR 4/2) coatings on faces of peds; thin patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; very dark grayish brown (10YR 3/2) organic coatings; common medium very dark gray (10YR 3/1) stains (iron and manganese oxides); neutral; diffuse smooth boundary.

C1—37 to 46 inches; brown (10YR 5/3) silt loam; few coarse distinct yellowish brown (10YR 5/6) mottles; weak thick platy structure; friable; thin bands of loamy fine sand; slight effervescence; mildly alkaline; clear smooth boundary.

C2g—46 to 60 inches; grayish brown (10YR 5/2) stratified silt loam and silty clay loam; few coarse prominent strong brown (7.5YR 5/8) mottles; weak thick platy structure; friable; strong effervescence; mildly alkaline.

Thickness of the solum and depth to free carbonates range from 24 to 42 inches. The solum is slightly acid or neutral.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is commonly loam, silt loam, silty clay loam, or clay loam and has thin subhorizons of fine sand in some pedons. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is commonly stratified fine sand, very fine sand, silt, silt loam, silty clay loam, or very fine sandy loam and has thin strata of clay loam or silty clay in some pedons.

Latty series

The Latty series consists of deep, very poorly drained soils formed in glacial lakebed sediments on lake plains. Permeability is very slow. Slope is 0 to 2 percent.

Latty soils are commonly adjacent to Hoytville, Nappanee, and Toledo soils and are similar to Bono and Toledo soils. Bono, Hoytville, and Toledo soils have a darker colored surface layer than Latty soils. Hoytville soils have an argillic horizon. Nappanee soils are somewhat poorly drained and are on slight rises and side slopes along drainageways. They are not dominantly gray in the subsoil.

Typical pedon of Latty silty clay, about 0.5 mile east of Clay Center, Allen Township, 1,700 feet east and 1,700 feet south of the northwest corner of sec. 15, T. 7 N., R. 13 E.

Ap—0 to 9 inches; dark gray (10YR 4/1) silty clay, light brownish gray (10YR 6/2) dry; moderate medium and fine angular blocky structure; firm; many roots; neutral; abrupt smooth boundary.

Bg1—9 to 20 inches; gray (5Y 5/1) silty clay; many fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; common roots; very dark gray (10YR 3/1) fillings in old root channels; neutral; clear smooth boundary.

Bg2—20 to 28 inches; gray (5Y 5/1) silty clay; common fine prominent dark yellowish brown (10YR 4/4) and common medium distinct dark brown (7.5YR 4/4) mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; common roots; few fine distinct black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

BCg—28 to 45 inches; gray (5Y 5/1) silty clay; common fine prominent dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to moderate medium and fine angular blocky; firm; common roots; few fine distinct black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Cg—45 to 60 inches; gray (5Y 5/1) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; slight effervescence; mildly alkaline.

Thickness of the solum ranges from 34 to 48 inches. The reaction in the solum is slightly acid or neutral.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 1 or 2. The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay or clay. The C horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is commonly silty clay, but some pedons have a 2C horizon of silty clay loam.

Lenawee series

The Lenawee series consists of deep, very poorly drained soils formed in silty and loamy glacial lakebed sediments on lake plains. Permeability is moderately slow. Slope is 0 to 2 percent.

Lenawee soils are commonly adjacent to Colwood, Del Rey, Haskins, Kibbie, Rimer, and Toledo soils and are also similar to Colwood, Latty, and Toledo soils. Colwood, Kibbie, and Rimer soils have more sand and less clay in the subsoil than Lenawee soils. Del Rey, Haskins, and Latty soils have an ochric epipedon. Del Rey, Haskins, Kibbie, and Rimer soils are somewhat poorly drained and are less gray in the subsoil. They are on slight rises and slopes along drainageways. Latty and Toledo soils contain more clay in the subsoil and have illitic mineralogy.

Typical pedon of Lenawee silty clay loam, about 2 miles west-northwest of Elmore, Harris Township, 250 feet east and 2,700 feet south of the northwest corner of sec. 14, T. 6 N., R. 13 E.

Ap—0 to 9 inches very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium and fine subangular blocky structure; friable; many roots; neutral; clear smooth boundary.

Bg1—9 to 17 inches; grayish brown (10YR 5/2) silty clay loam, pale brown (10YR 6/3) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; friable; common roots; dark grayish brown (10YR 4/2) coatings on faces of peds; neutral; clear smooth boundary.

Bg2—17 to 23 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common roots; grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) coatings on faces of peds; neutral; clear smooth boundary.

Bg3—23 to 33 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; few roots; grayish brown (10YR 5/2) coatings on faces of peds; neutral; clear smooth boundary.

Bg4—33 to 42 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; few roots; neutral; clear smooth boundary.

BCg—42 to 49 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few roots; neutral; clear smooth boundary.

Cg—49 to 60 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few roots in vertical cracks; few coarse fragments; mildly alkaline.

Thickness of the solum ranges from 30 to 50 inches. The solum is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is commonly silty clay loam or clay loam. Thin lenses of silt loam or silty clay are in some pedons. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is commonly silty clay loam or silt loam. Lenses of very fine sand are in some pedons.

Millsdale series

The Millsdale series consists of moderately deep, very poorly drained soils formed in water-modified glacial till over limestone bedrock on lake plains. Permeability is moderately slow. Slope is 0 to 2 percent.

These soils have less clay in the argillic horizon than is definitive for the Millsdale series. This difference, however, does not alter the usefulness or behavior of the soils.

Millsdale soils are commonly adjacent to Castalia, Hoytville, Lenawee, Milton, and Nappanee soils. Castalia, Milton, and Nappanee soils are better drained than Millsdale soils and are on slight rises and knolls. They are less gray in the subsoil. Castalia soils have more sand and rock fragments throughout the soil. Lenawee soils are similar in position to Millsdale soils. Lenawee and Hoytville soils are deep to bedrock. Lenawee soils have a cambic horizon.

Typical pedon of Millsdale silty clay loam, about 1 mile southwest of Genoa, Clay Township, 550 feet east and 690 feet north of the southwest corner of sec. 4, T. 6 N., R. 13 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate medium and fine subangular blocky structure; very friable; many roots; 2 percent coarse fragments; neutral; clear wavy boundary.

Btg1—10 to 13 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; friable; many roots; thin patchy very dark grayish brown (10YR 3/2) clay films on faces of peds; 2 percent coarse fragments; common medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; clear wavy boundary.

Btg2—13 to 19 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/4 and 5/8) mottles; moderate medium and coarse angular blocky structure; firm; common roots; thin continuous gray (10YR 5/1) clay films on faces of peds; 4 percent coarse fragments; common medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; diffuse smooth boundary.

Btg3—19 to 29 inches; brown (10YR 5/3) silty clay loam; many medium distinct yellowish brown (10YR 5/6) and common medium distinct dark grayish brown (10YR 4/2) mottles; moderate coarse and medium angular blocky structure; firm; common roots; thin gray (10YR 5/1) clay films on faces of peds—continuous on vertical faces and very patchy on horizontal faces; 8 percent coarse fragments; common medium black (10YR 2/1) concretions (iron and manganese oxides); neutral; abrupt wavy boundary.

2R—29 inches; limestone bedrock.

Thickness of the solum and depth to bedrock range from 20 to 40 inches. Thickness of the mollic epipedon ranges from 10 to 14 inches.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 3. It is neutral in the upper part and neutral or mildly alkaline in the lower part.

Milton series

The Milton series consists of moderately deep, well drained soils formed in glacial till over limestone bedrock on knolls and flats. Permeability is moderately slow. Slope ranges from 2 to 6 percent.

Milton soils are commonly adjacent to Castalia, Millsdale, Nappanee, and Rawson soils and are similar to Rawson soils. Castalia soils contain more rock fragments and sand throughout than Milton soils. Millsdale soils are on flats and in depressions. They have a mollic epipedon. Nappanee and Rawson soils are deeper to bedrock. The somewhat poorly drained Nappanee soils and very poorly drained Millsdale soils are more gray in the subsoil. Rawson soils have more sand and less clay in the middle and upper parts of the subsoil.

Typical pedon of Milton silt loam, 2 to 6 percent slopes, about 2 miles southwest of Marblehead, Danbury Township, 550 feet east along Bay Shore Rd. from the intersection of Bay Shore and Hartshorn Rds., then 120 feet north of Bay Shore Rd.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure parting to moderate medium and fine granular; friable; many roots; 10 percent coarse fragments; neutral; abrupt smooth boundary.

Bt1—6 to 13 inches; brown (7.5YR 4/4) silty clay; strong medium subangular blocky structure; very firm; common roots; brown (7.5YR 5/4) coatings and medium continuous clay films on faces of peds; 3 percent coarse fragments; slightly acid; clear smooth boundary.

Bt2—13 to 22 inches; brown (7.5YR 4/4) silty clay; weak medium subangular blocky structure; very firm; common roots; yellowish brown (10YR 5/6) coatings and thin patchy clay films on faces of peds; 5 percent coarse fragments; slightly acid; clear smooth boundary.

Bt3—22 to 28 inches; brown (7.5YR 4/4) silty clay; weak medium subangular blocky structure; firm; common roots; thin patchy yellowish brown (10YR 5/4) clay films on faces of peds; 5 percent coarse fragments; mildly alkaline; abrupt smooth boundary.

Bt4—28 to 36 inches; brown (7.5YR 5/4) clay loam; weak medium subangular blocky structure; firm; few roots; thin patchy brown (7.5YR 4/4) clay films on faces of peds; 10 percent coarse fragments; common distinct pinkish gray (7.5YR 7/2) carbonate coatings on faces of peds; strong effervescence; mildly alkaline; abrupt smooth boundary.

2R—36 inches; gray (10YR 6/1) hard limestone bedrock.

Thickness of the solum ranges from 20 to 40 inches and corresponds to the depth to bedrock. The reaction is neutral or slightly acid in the upper part of the soil and neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR through 5YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay, silty clay loam, or clay loam.

Nappanee series

The Nappanee series consists of deep, somewhat poorly drained soils formed in water-modified glacial till on the lake plains. Permeability is slow. Slope ranges from 0 to 3 percent.

Nappanee soils are commonly adjacent to Del Rey, Haskins, Hoytville, Latty, St. Clair, and Toledo soils and are similar to Del Rey and Haskins soils. Del Rey soils formed in lakebed sediments and have less clay in the subsoil and substratum than Nappanee soils. Haskins soils formed in glacial outwash over glacial till or lacustrine material and have less clay in the upper and middle parts of the subsoil. Hoytville, Latty, and Toledo soils are wetter and are grayer in the subsoil. They are slightly lower on the landscape. St. Clair soils are better drained and do not have gray mottles immediately under the plow layer.

Typical pedon of Nappanee silty clay loam, 0 to 3 percent slopes, near the west side of Oak Harbor, Salem Township, 825 feet east and 2,475 feet north of the southwest corner of sec. 5, T. 6 N., R. 15 E.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silty clay loam, pale brown (10YR 6/3) dry; moderate medium and fine subangular blocky structure; friable; many roots; medium acid; clear smooth boundary.

Bt1—8 to 14 inches; dark brown (10YR 4/3) silty clay; common medium distinct yellowish brown (10YR 5/6) and common fine faint dark grayish brown (10YR 4/2) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; firm; many roots; grayish brown (10YR 5/2) continuous coatings and thin patchy clay films on faces of peds; few fine black (10YR 2/1) stains (iron and manganese oxides); medium acid; clear smooth boundary.

Bt2—14 to 23 inches; dark brown (10YR 4/3) silty clay; common medium distinct yellowish brown (10YR 5/6) and common fine faint dark grayish brown (10YR 4/2) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; many roots; dark grayish brown (10YR 4/2) continuous coatings; thin continuous clay films on faces of peds; few fine black (10YR 2/1) stains (iron and manganese oxides); medium acid; diffuse smooth boundary.

Bt3—23 to 27 inches; dark brown (10YR 4/3) silty clay; common medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; common roots; grayish brown (10YR 5/2) continuous coatings and thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; common medium black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

BC—27 to 34 inches; dark brown (10YR 4/3) silty clay; common medium distinct yellowish brown (10YR 5/6), common medium distinct gray (10YR 5/1), and few medium distinct reddish brown (5YR 5/3) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; few roots; few thin very patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; common medium black (10YR 2/1) stains (iron and manganese oxides); slight effervescence; mildly alkaline; clear smooth boundary.

C1—34 to 47 inches; dark brown (10YR 4/3) silty clay; common medium distinct yellowish brown (10YR 5/6) and gray (10YR 6/1) mottles; massive; very firm; few roots; common medium distinct light gray (10YR 7/2) secondary lime deposits; common fine black (10YR 2/1) stains (iron and manganese oxides); slight effervescence; mildly alkaline; diffuse smooth boundary.

C2—47 to 60 inches; dark brown (10YR 4/3) silty clay; common medium distinct gray (10YR 5/1), common medium distinct yellowish brown (10YR 5/6), and few medium distinct reddish brown (5YR 5/3) mottles; massive; very firm; less than 2 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum and depth to free carbonates range from 26 to 40 inches. The reaction of the solum ranges from medium acid to neutral in the upper part, and it is neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is silty clay or clay. The C horizon is silty clay loam or silty clay.

Oakville series

The Oakville series consists of deep, well drained, rapidly permeable soils formed in sandy deposits on long, narrow beach ridges along a lake. Slope ranges from 2 to 8 percent.

Oakville soils are commonly adjacent to Glendora and Algansee soils. Glendora and Algansee soils are wetter and are more gray in the upper part of the substratum than Oakville soils. These soils are in lower positions on the landscape.

Typical pedon of Oakville fine sand, 2 to 8 percent slopes, about 8 miles northeast of Port Clinton, Danbury Township, East Harbor State Park, 1,570 feet southeast along Beach Road from the intersection of Beach Road and Park Causeway, then 90 feet east.

A—0 to 4 inches; very dark gray (10YR 3/1) fine sand, very dark gray (10YR 3/1) dry; single grained; loose; many roots; slightly acid; abrupt wavy boundary.

Bw—4 to 26 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; common roots; gray (10YR 3/1) organic stains and fillings in old root channels; slightly acid; clear smooth boundary.

BC—26 to 40 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; black (10YR 2/1) organic stains and fillings in old root channels; medium acid; clear smooth boundary.

C1—40 to 50 inches; brown (10YR 5/3) fine sand; single grained; loose; slightly acid; clear smooth boundary.

C2—50 to 60 inches; brown (10YR 5/3) fine sand; single grained; loose; neutral.

Thickness of the solum ranges from 30 to 40 inches.

The A horizon has hue of 10YR, value of 2 to 4, and chroma of 1 or 2. The B and C horizons have hue of 10YR, value of 5, and chroma of 3 to 5. The B horizon is fine sand or loamy fine sand.

Rawson series

The Rawson series consists of deep, moderately well drained and well drained soils. They formed in loamy glacial outwash and in the underlying lacustrine material or glacial till on lake plains and stream terraces. Permeability is moderate through the outwash and slow or very slow through the underlying material. Slope ranges from 2 to 6 percent.

These soil have gray mottles at a shallower depth than is defined as the range for the Rawson series. This difference, however, does not alter the use or behavior of the soils.

Rawson soils are commonly adjacent to Dunbridge, Genesee, Haskins, Milton, and Nappanee soils and are similar to Milton soils. Dunbridge and Milton soils are on a landscape controlled by bedrock and have limestone bedrock at a depth of 20 to 40 inches. Genesee soils do not have an argillic horizon and are on flood plains. Haskins and Nappanee soils are somewhat poorly drained, are grayer in the subsoil, and are on slight rises.

Typical pedon of Rawson loam, 2 to 6 percent slopes, about 1.5 miles north of Elmore, Harris Township, 2,020 feet east and 660 feet north of the southwest corner of sec. 8, T. 6 N., R. 14 E.

Ap—0 to 10 inches; dark brown (10YR 3/3) loam, light brownish gray (10YR 6/2) dry; moderate medium and fine granular structure; friable; many roots; about 3 percent gravel; medium acid; abrupt smooth boundary.

Bt1—10 to 17 inches; dark yellowish brown (10YR 4/4) gravelly loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; many roots; continuous brown (10YR 3/3) coatings and thin patchy dark brown (10YR 3/3) clay films on faces of peds; very dark grayish brown (10YR 3/2) organic stains on faces of peds; 15 percent gravel; medium acid; clear smooth boundary.

Bt2—17 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct strong brown (7.5YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; moderate medium and fine subangular blocky structure; friable; many roots; dark brown (10YR 3/3) continuous coatings and thin continuous clay films on faces of peds; 10 percent gravel; slightly acid; abrupt smooth boundary.

2Bt3—23 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; strong coarse and medium subangular blocky structure; very firm; common roots; dark grayish brown (10YR 4/2) continuous coatings and thin patchy clay films on faces of peds; 5 percent gravel; neutral; clear smooth boundary.

2BC—35 to 38 inches; brown (10YR 4/3) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very firm; few roots; dark grayish brown (10YR 4/2) coatings on faces of peds; about 7 percent gravel; strong effervescence; mildly alkaline; clear smooth boundary.

2C1—38 to 45 inches; brown (10YR 4/3) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and few medium faint dark grayish brown (10YR 4/2) mottles; massive; very firm; about 7 percent gravel; many light gray (10YR 7/2) secondary lime deposits; strong effervescence; moderately alkaline; clear smooth boundary.

2C2—45 to 60 inches; brown (10YR 4/3) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and few medium faint dark grayish brown (10YR 4/2) mottles; massive; very firm; 5 percent gravel; many light gray (10YR 7/2) secondary lime deposits; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 30 to 48 inches. Thickness of the loamy outwash ranges from 22 to 40 inches. The solum is medium acid to neutral in the upper part and neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is sandy clay loam, loam, clay loam, or silty clay loam and the gravelly analogs of these textures. The 2B horizon has the same range in colors as the B horizon. It is silty clay or silty clay loam. The 2C horizon has hue of 10YR to 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay or silty clay loam.

Rimer series

The Rimer series consists of deep, somewhat poorly drained soils on low beach ridges on lake plains. They are formed in sandy and loamy materials and in the underlying lacustrine sediments. Permeability is rapid in the upper part of the profile and slow in the lower part. Slope is 0 to 2 percent.

These soils have a thinner sandy surface horizon and a thinner clayey layer in the subsoil and substratum than is definitive for the Rimer series. These differences do not alter the usefulness or behavior of the soils.

Rimer soils are commonly adjacent to Colwood, Del Rey, Haskins, Kibbie, and Lenawee soils which have less sand in the upper part of the subsoil than Rimer soils. Colwood and Lenawee soils are very poorly drained and are more gray in the subsoil than Rimer soils. They are on flats and in narrow concave areas.

Typical pedon of Rimer loamy fine sand, stratified substratum, 0 to 2 percent slopes, about 3 miles south-southwest of Rocky Ridge, Harris Township, 2,970 feet south and 1,500 feet west of the northeast corner of sec. 9, T. 6 N., R. 14 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/4) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many roots; strongly acid; abrupt wavy boundary.

BE—9 to 14 inches; grayish brown (10YR 5/2) loamy fine sand; common medium distinct yellowish brown (10YR 5/6) and few medium distinct strong brown (7.5YR 5/8) mottles; weak fine granular structure; very friable; many roots; clay globules within loamy sand; common fine distinct very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); strongly acid; clear smooth boundary.

Bt1—14 to 26 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) mottles; weak medium and fine subangular blocky structure; very friable; common roots; dark grayish brown (10YR 4/2) coatings and thin patchy clay films on faces of peds; dark grayish brown (10YR 4/2) fillings in old root channels; common medium black (10YR 2/1) stains (iron and manganese oxides); strongly acid; abrupt smooth boundary.

2Bt2—26 to 37 inches; dark brown (7.5YR 4/4) silty clay; common medium prominent gray (10YR 5/1) and few medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; common roots; brown (7.5YR 5/2) coatings and thin patchy clay films on faces of peds; neutral; abrupt smooth boundary.

3C1—37 to 52 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure parting to medium and fine subangular blocky; firm; few roots; 2-inch band of dark brown (10YR 3/3) sand and gravel; thin continuous grayish brown (10YR 5/2) silt coatings on vertical faces of peds; 1 or 2 percent coarse fragments; light gray (10YR 7/2) secondary lime deposits; common fine black (10YR 2/1) stains (iron and manganese oxides); strong effervescence; moderately alkaline; clear smooth boundary.

3C2—52 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; few medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; few roots; thin continuous grayish brown (10YR 5/2) silt coatings on vertical faces of peds; light gray (10YR 7/2) secondary lime deposits; 1 or 2 percent coarse fragments; common fine black (10YR 2/1) stains (iron and manganese oxides); strong effervescence; mildly alkaline.

Thickness of the solum and depth to free carbonates range from 30 to 42 inches. Thickness of sandy and loamy materials ranges from 20 to 32 inches.

The Ap horizon is strongly acid to neutral. The B horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is loamy fine sand or sandy loam and strongly acid to neutral. The 2B horizon is silty clay, clay, or silty clay loam and slightly acid to mildly alkaline. The C horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It is stratified with textures of silty clay loam and silt loam. Thin lenses of sand and pea-size gravel are common.

St. Clair series

The St. Clair series consists of deep, moderately well drained soils formed in water-modified glacial till on lake plains. Permeability is slow or very slow. Slope ranges from 4 to 12 percent.

St. Clair soils are commonly adjacent to Genesee, Hoytville, Nappanee, Shoals, and Wabasha soils. Genesee, Shoals, and Wabasha soils formed in alluvium on flood plains. They have an irregular decrease in organic matter with depth. Hoytville, Nappanee, and Wabasha soils are wetter and are grayer in the subsoil than St. Clair soils.

Typical pedon of St. Clair silty clay loam, 4 to 12 percent slopes, eroded, about 3 miles east of Genoa, Benton Township, and 785 feet north and 90 feet east of the southwest corner of sec. 31, T. 7 N., R. 14 E.

Ap—0 to 7 inches; dark brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; friable; many roots; dark grayish brown (10YR 4/2) organic stains; less than 2 percent coarse fragments; neutral; abrupt smooth boundary.

Bt1—7 to 13 inches; dark yellowish brown (10YR 4/4) silty clay; few medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; many roots; thin patchy dark brown (10YR 4/3) clay films on faces of peds; dark grayish brown (10YR 4/2) fillings in worm casts; about 7 percent coarse fragments; neutral; clear smooth boundary.

Bt2—13 to 19 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; many roots; thin patchy dark brown (10YR 4/3) clay films on faces of peds; about 7 percent coarse fragments; neutral; abrupt smooth boundary.

Bt3—19 to 23 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 4/3) clay films on faces of peds; dark brown (10YR 4/3) fillings in root channels; about 7 percent coarse fragments; light gray (10YR 7/2) secondary lime deposits; strong effervesence; moderately alkaline; clear smooth boundary.

C1—23 to 40 inches; dark yellowish brown (10YR 4/4) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; massive with horizontal cleavage; very firm; about 8 percent coarse fragments; light gray (10YR 7/2) secondary lime deposits; strong effervescence; moderately alkaline; clear smooth boundary.

C2—40 to 60 inches; dark brown (10YR 4/3) silty clay; few coarse faint dark grayish brown (10YR 4/2) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; very firm; about 8 percent coarse fragments; common medium distinct black (10YR 2/1) stains (iron and manganese oxides); light gray (10YR 7/2) secondary lime deposits; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 20 to 30 inches. Reaction ranges from medium acid to neutral in the upper part of the solum and is mildly alkaline or moderately alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 3 or 4. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4.

Shoals series

The Shoals series consists of deep, somewhat poorly drained, moderately permeable soils formed in recent alluvium on flood plains. Slope is 0 to 2 percent.

Shoals soils are commonly adjacent to Genesee, Nappanee, Rawson, St. Clair, and Wabasha soils. Genesee, Rawson, and St. Clair soils are better drained and are not gray immediately under the surface layer. Nappanee, Rawson, and St. Clair soils have an argillic horizon. Nappanee and St. Clair soils are on lake plains, and Rawson soils are on terraces. Genesee and Wabasha soils are on flood plains. Wabasha soils are wetter and are grayer in the subsoil than Shoals soils.

Typical pedon of Shoals silt loam, frequently flooded, about 3.5 miles west of Rocky Ridge, Benton Township, 180 feet west and 2,622 feet north of the southeast corner of sec. 30, T. 7 N., R. 14 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; friable; many roots; neutral; clear smooth boundary.

C1—10 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; friable; many roots; common fine very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); neutral; clear smooth boundary.

C2—20 to 29 inches; brown (10YR 4/3) silty clay loam; many fine distinct yellowish brown (10YR 5/6) and common medium faint dark grayish brown (10YR 4/2) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; friable; many roots; dark grayish brown (10YR 4/2) fillings in pores; common fine very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); neutral; clear smooth boundary.

Cg1—29 to 47 inches; grayish brown (10YR 5/2) clay loam; many medium prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; firm; common roots; common fine very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); 1/8 inch thick fine sand seams; neutral; clear smooth boundary.

Cg2—47 to 60 inches; gray (10YR 5/1) silty clay loam; common coarse prominent strong brown (7.5YR 5/6) and few medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few roots; neutral.

The soil is neutral or slightly acid in the upper part and is neutral or mildly alkaline in the lower part.

The Ap horizon has hue of 10YR and value of 3 or 4. The C horizon above a depth of about 29 inches has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silty clay loam, silt loam, or clay loam. The C horizon below a depth of about 29 inches has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 to 3. It is silty clay loam that has thin strata of sand and gravel.

Toledo series

The Toledo series consists of deep, very poorly drained, slowly permeable soils formed in clayey glacial lakebed sediments on lake plains. Slope is 0 to 2 percent.

Toledo soils are commonly adjacent to Haskins, Latty, Lenawee, and Nappanee soils and are similar to Bono, Hoytville, Latty, and Lenawee soils. Bono soils have a mollic epipedon. Haskins and Nappanee soils are somewhat poorly drained and are on slight rises and side slopes along drainageways. They are less gray in the subsoil than Toledo soils. Haskins, Latty, and Nappanee soils have an ochric epipedon. Hoytville soils have an argillic horizon. Lenawee soils have less clay in the subsoil and substratum.

Typical pedon of Toledo silty clay, about 6 miles southwest of Port Clinton, Bay Township, 2,310 feet east and 1,650 feet north of the southwest corner of sec. 17, T. 6 N., R. 16 E.

Ap— 0 to 7 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; firm; many roots; many krotovinas; neutral; clear smooth boundary.

BAg—7 to 10 inches; dark gray (5Y 4/1) silty clay; common medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium subangular blocky structure; firm; common roots; gray (10YR 5/1) coatings on faces of peds; many krotovinas; neutral; clear smooth boundary.

Bg1—10 to 16 inches; gray (5Y 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse angular blocky structure; firm; common roots; gray (10YR 5/1) coatings on faces of peds; many krotovinas; few medium black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Bg2—16 to 20 inches; gray (5Y 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine angular blocky structure; firm; few roots; gray (10YR 5/1) coatings on faces of peds; many krotovinas; few medium black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Bg3—20 to 32 inches; gray (5Y 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; few roots; dark grayish brown (2.5Y 4/2) coatings on faces of peds; many krotovinas; few fine black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

BCg—32 to 48 inches; gray (5Y 5/1) silty clay; common coarse distinct dark brown (7.5YR 4/4) mottles; massive; firm; few roots; common krotovinas; common medium black (10YR 2/1) stains (iron and manganese oxides); neutral; clear smooth boundary.

Cg—48 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay; common coarse distinct dark gray (N 4/0) and yellowish brown (10YR 5/6) mottles; massive; firm; common fine black (10YR 2/1) stains (iron and manganese oxides); slight effervescence; mildly alkaline.

Thickness of the solum ranges from 36 to 50 inches. The solum is slightly acid or neutral.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 0 to 2. The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 0 to 2. It is silty clay or clay. The C horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 0 to 2. It is silty clay or clay.

Wabasha series

The Wabasha series consists of deep, very poorly drained, slowly permeable soils formed in recent alluvium along streams of low gradient on lake plains. Slope is 0 to 2 percent.

These soils have mixed mineralogy rather than the illitic mineralogy defined as characteristic of the Wabasha soils elsewhere. This difference, however, does not alter the usefulness or behavior of the soils.

Wabasha soils are commonly adjacent to Genesee, Shoals, St. Clair, and Toledo soils. Genesee and Shoals soils are better drained, are on slightly higher positions on flood plains, and are less gray between depths of 10 and 40 inches than Wabasha soils. St. Clair and Toledo soils have a regular decrease in organic matter with depth. St. Clair soils are on slope breaks, and Toledo soils are on broad flats and in depressions on the lake plains.

Typical pedon of Wabasha silty clay, frequently flooded, about 0.1 mile west of Martin, Clay Township, 60 feet west and 725 feet south of the northeast corner of sec. 22, T. 7 N., R. 13 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; moderate medium and fine subangular blocky structure; friable; many roots; neutral; clear smooth boundary.

A—9 to 20 inches; very dark grayish brown (10YR 3/2) silty clay, light brownish gray (2.5Y 6/2) dry; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; many roots; very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; clear smooth boundary.

Bg1—20 to 31 inches; grayish brown (10YR 5/2) silty clay; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; dark grayish brown (10YR 4/2) coatings on faces of peds; few fine very dark gray (10YR 3/1) stains (iron and manganese oxides); about 1 percent gravel; neutral; clear smooth boundary.

Bg2—31 to 41 inches; grayish brown (10YR 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; dark grayish brown (10YR 4/2) coatings on faces of peds; common medium very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); about 1 percent gravel; neutral; clear smooth boundary.

Bg3—41 to 50 inches; grayish brown (10YR 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; common medium very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); about 7 percent gravel; neutral; clear smooth boundary.

Cg—50 to 60 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/8) mottles; massive; firm; few roots along vertical breaks; gray (10YR 5/1) fillings in vertical breaks; common medium very dark grayish brown (10YR 3/2) stains (iron and manganese oxides); about 7 percent gravel; neutral.

Thickness of the solum ranges from 40 to 50 inches. The solum is neutral in the upper part and neutral or mildly alkaline in the lower part.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly silty clay but is silty clay loam in some pedons. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 0 to 2. It is silty clay or clay. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 4.

formation of the soils

This section discusses the factors and processes of soil formation and explains the effects they have had on the formation of soils in Ottawa County.

factors of soil formation

Unique soils are formed as a result of complex interactions among principal soil-forming factors. How soils were formed and thus acquired their present character at any given geographical point depends upon the factors of: (1) physical and mineralogical composition of the parent material, (2) the relief, (3) the climate under which the soil material has formed, (4) plant and animal life in and on the soil, and (5) the duration of time during which the forces of soil forming have acted upon the parent material.

Climate, vegetation, and animals are active factors in soil formation. The vegetative, animal, and microbial life, infuenced by climate, act upon parent material and gradually change it into a natural body having genetically related horizons. The effects of climate and vegetation during soil development are modified by parent material and the relief which influences drainage. The parent material and relief determine the kind of soil profile that is formed, and in some cases dominate the other factors of soil formation.

Time is required in order that active soil forming factors can transform parent material into soil. Weathering, leaching, translocation of soil particles, formation of soil structure, and other soil-forming processes require time to differentiate horizons in soil parent material.

parent material

Parent material of mineral soils in which a soil forms is the unconsolidated mass of fine earth material resulting from the weathering of rocks. Some kinds of parent material are derived from bedrock in place, some have been transported into the county by glaciers, and some have been transported by water. This parent material largely determines the chemical and mineralogical composition of soils.

In Ottawa County parent materials originated from glaciofluvial deposits, glacial till, lacustrine sediments, bedrock, and recent stream alluvium. Soils formed from lacustrine sediments are the most extensive. Toledo, Latty, and Bono soils are a few examples. Soils formed from glaciofluvial deposits generally have a loamy textured surface layer and subsoil underlain by glacial till below a depth of 60 inches. Examples of these soils are the Colwood and Kibbie soils. Some soils in the county are formed in waterworked glacial till. Some examples of these soils are the Hoytville, Nappanee, and St. Clair soils. Other soils in the county, such as Castalia soils, are derived from parent material weathered in place. Soils on flood plains formed in recent alluvium. They are commonly fine or medium textured and have little or no profile development. Examples are the Genesee and Wabasha soils.

climate

Ottawa County has a climate characterized as humid, temperate, and continental. Soils in the county developed under the influence of this type of climate in a region mostly covered with deciduous hardwood forest.

One of the main reasons that climate is important to soil development is that it regulates the rate of weathering and decomposition of minerals in the soil. Precipitation, temperature, and the evapo-transpiration ratio are climatic factors closely related to the plant and animal communities and affect the kinds of soil that are formed in a region. In an area the size of Ottawa County, the climate is fairly uniform and soil differences are more related to other soil-forming factors such as parent material, relief, and the age of soil materials.

The climate also influences the removal of material within the soil profile by leaching. Because soluble bases are removed as they are released by decomposition from mineral material, the soils that form are increasingly acid. Translocation of clay and sesquioxides is accomplished as water percolates from the surface down to lower horizons. Most soils of the county are naturally neutral to slightly acid, at least in the upper horizons, because the bases are continually leached downward. Hoytville, Nappanee, and St. Clair soils show evidence of clay movement from the "A" to the "B" horizon.

The Toledo, Bono, Latty, Lenawee, and Colwood soils, because of their relatively low position on the landscape, have formed under a wetter microclimate than adjoining soils in more elevated positions. As a result they are saturated for extended lengths of time and gleyed by the reduction and leaching of iron.

All soils in Ottawa County are classified in the mesic family category based on soil temperatures (see table 18). The average annual soil temperature 20 inches below the surface is approximately 2 degrees F higher than the average annual air temperature.

A further discussion of climatic data for the county is given in the section "General Nature of the County."

relief

Relief influences soil development by its effect on water relationships, erosion, local temperature relationships, and vegetative cover. Surface runoff, ponding, depth to water table, internal drainage, accumulation and removal of organic matter, and other phenomena are affected either directly or indirectly by relief.

Relief in a humid climate, such as in Ottawa County, can account for the development of different soils from the same kind of parent material because differences in relief cause differences in natural drainage conditions. For this reason, relief is often most reliable in differentiating the external features of soil series. Commonly, a given set of soil characteristics is indirectly related to the slope and internal drainage. This can be seen in comparing the somewhat poorly drained Nappanee soils with the moderately well drained St. Clair soils, both of which have formed in a similar kind of Wisconsin age glacial till.

Rainfall that does not infiltrate into the soil runs off and collects on soils in depressions or is removed through the natural surface drainage system. Therefore, from equivalent rainfall, sloping soils receive less water and depressional soils receive more water than soils that are gently sloping. Frequent or periodic movement of water through the gently sloping soils commonly shows they they have the greatest degree of development, because they are not saturated and a significant amount of water moves down through them.

living organisms

All living organisms play a role in the process of soil formation. These include vegetation, animals, bacteria, and fungi. The vegetation is generally responsible for the amount of organic matter, color of the surface layer, and the principal amount of available nutrients in the natural soil. Earthworms, cicadas, and burrowing animals help keep the soil open and porous. Bacteria and fungi decompose the vegetation, releasing nutrients for plant food. Man has also influenced soil formation where he has cleared the trees and plowed the land. He has added fertilizers, mixed some of the upper horizons, and moved the soil material from place to place.

The original vegetation in Ottawa County was primarily deciduous forest. The very poorly drained Toledo, Hoytville, Colwood, and Latty soils were dominated by the elm-ash swamp-forest. Common species include American and slippery elm, black ash, silver maple, pin oak, swamp white oak, American sycamore, and black gum trees and, on slightly better drained spots, bur oak, white oak, and shellbark hickory. Trees characteristic of the better drained Castalia and Milton soils were of the mixed oak forest type of mainly red cedar and a mixed forest of black maple, black walnut, sugar maple, slippery elm, blue ash, and bitternut hickory. Parts of Carroll, Erie, Bay, Portage, Danbury, and Benton Townships were in freshwater marshes and fens. Toledo, ponded, Algansee, and Glendora soils are common in these areas.

time

The length of time that parent material has been exposed to soil-forming elements is important to soil development. Within relatively broad limits, the longer the time that climatic elements and plant and animal life have acted upon parent material, the more distinct become the horizons of the soil profile.

The soils of Ottawa County have developed in the period since the last glaciation, which is about 10,000 to 15,000 years. In the steeper areas where geologic erosion has kept pace with development, the horizons are thinner and the depth to parent material is less. St. Clair soils are an example. On broad flats, however, the soil profiles are thicker and depth to parent material is generally more than 36 inches. An example would be the Hoytville soils.

Soils that formed in recent alluvium, such as Genesee soils, have no strongly differentiated horizons. Not enough time has elapsed for other soil-forming factors to significantly influence these soils. They are the youngest and least developed in the county.

processes of soil formation

Basic chemical and physical processes such as oxidation, reduction, hydration, hydrolysis, solution, eluviation (leaching), and illuviation (accumulation), and other highly complex processes bring about additions to, losses from, transfers, and chemical changes within soils. These many processes, influenced by the interrelationships of the soil-forming factors, are responsible for the changing of parent materials by steps or stages, none of which are distinct, to a youthful soil and finally to a mature soil or to a soil that is in equilibrium with its environment.

Additions to soils are made by additions of organic matter, by sediment depositions, or by accumulating nutrients and colloidal material from sources such as organic matter, ground water, lime, and fertilizers. Most virgin soils in the county, except perhaps those on flood plains, have a surface layer of organic accumulation known as an A1 horizon. Cultivation, however, has since mixed this layer with other layers and removed all evidence of the original horizon from the profile. Some nutrients move in a cycle from soil to plants and then back to the soil as by-products of organic matter decomposition. This is true for all soils in the county except where this process is modified by the harvesting of crops. The alluvial Wabasha and Genesee soils periodically receive sediment deposits from floodwaters.

Soil losses commonly occur by erosion, leaching of soluble salts, eluviation of colloids with percolating water, and nutrient losses where crops are harvested. Leaching of carbonates accounts for the most significant soil nutrient losses in Ottawa County. Carbonates have been removed to a depth of 20 to 40 inches from the Nappanee and St. Clair soils. The parent material of these soils contained 15 to 25 percent calcium carbonate equivalent, and they are now slightly acid in reaction, which indicates that a tremendous change has been effected by the leaching process. Other minerals present in soils often break down through a complicated series of processes and eventually are lost through leaching, but at a slower rate than carbonates.

The decomposition of other minerals often produces free iron oxides that cause the fairly bright brownish colors in the St. Clair and Rawson soils. The periodic, or seasonal, high water table in Toledo, Bono, Hoytville, Latty, and similar soils causes a reduction of iron oxides. This process is primarily responsible for subsoil colors in these soils.

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glossary

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified

organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.
B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.
C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.
R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees ir a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subhorizons of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1972-78 at Ottawa, Ohio]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	31.2	14.8	23.0	63	-9	18	1.89	.64	2.91	5	6.6
February---	34.8	16.5	25.7	64	-10	12	1.36	.50	2.06	4	6.5
March------	48.3	30.3	40.1	76	6	26	2.98	1.79	4.03	7	2.5
April------	60.2	38.8	49.5	85	22	138	2.76	1.26	4.03	5	.2
May--------	71.0	49.4	60.2	91	29	339	3.08	2.38	3.72	7	.0
June-------	80.5	58.7	69.6	94	43	588	4.64	1.94	6.91	7	.0
July-------	84.8	61.6	73.5	98	48	729	2.79	.64	4.48	5	.0
August-----	82.3	59.8	70.9	94	45	648	3.80	1.42	5.79	6	.0
September--	74.9	51.9	63.4	94	33	402	3.81	1.46	5.77	6	.0
October----	63.4	40.6	52.0	81	20	127	2.10	1.11	2.97	5	.0
November---	49.6	32.7	41.2	78	12	35	2.67	1.07	4.02	7	1.3
December---	35.7	20.8	28.3	63	-6	0	2.42	1.19	3.48	7	9.2
Yearly:											
Average--	59.7	39.7	49.8	---	---	---	---	---	---	---	---
Extreme--	---	---	---	99	-13	---	---	---	---	---	---
Total----	---	---	---	---	---	3,062	34.30	26.10	40.14	71	26.3

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1972-78 at Ottawa, Ohio]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 21	April 30	May 5
2 years in 10 later than--	April 13	April 25	May 3
5 years in 10 later than--	March 29	April 16	April 30
First freezing temperature in fall:			
1 year in 10 earlier than--	October 12	October 5	September 25
2 years in 10 earlier than--	October 17	October 10	September 30
5 years in 10 earlier than--	October 25	October 20	October 9

TABLE 3.--GROWING SEASON

[Recorded in the period 1972-78 at Ottawa, Ohio]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	174	167	152
8 years in 10	186	173	156
5 years in 10	209	186	162
2 years in 10	232	199	168
1 year in 10	244	205	172

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ag	Algansee fine sand, occasionally flooded	289	0.2
Bo	Bono silty clay	2,057	1.2
ChB	Castalia very stony fine sandy loam, 1 to 6 percent slopes	5,173	3.0
Co	Colwood loam	1,896	1.1
DeA	Del Rey silt loam, 1 to 3 percent slopes	1,427	0.8
DuB	Dunbridge fine sandy loam, 2 to 6 percent slopes	354	0.2
Gn	Genesee silt loam, frequently flooded	1,041	0.6
Go	Genesee Variant loam, frequently flooded	135	0.1
Gr	Glendora loamy fine sand, frequently flooded	328	0.2
HaA	Haskins loam, 0 to 3 percent slopes	1,902	1.1
Hy	Hoytville silty clay loam	19,502	11.3
KfA	Kibbie fine sandy loam, 0 to 2 percent slopes	2,715	1.6
Lc	Latty silty clay	2,859	1.7
Lf	Lenawee silty clay loam	4,915	2.9
Mh	Millsdale silty clay loam	551	0.3
MtB	Milton silt loam, 2 to 6 percent slopes	2,140	1.2
NpA	Nappanee silty clay loam, 0 to 3 percent slopes	32,908	19.1
OaB	Oakville fine sand, 2 to 8 percent slopes	338	0.2
Pt	Pits, quarry	2,717	1.6
RaB	Rawson loam, 2 to 6 percent slopes	882	0.5
RmA	Rimer loamy fine sand, stratified substratum, 0 to 2 percent slopes	867	0.5
SbC2	St. Clair silty clay loam, 4 to 12 percent slopes, eroded	2,946	1.7
Sh	Shoals silt loam, frequently flooded	525	0.3
To	Toledo silty clay	57,394	33.3
Tp	Toledo silty clay, ponded	12,058	7.0
Ud	Udorthents, gently sloping	2,370	1.4
Wa	Wabasha silty clay, frequently flooded	1,595	0.9
	Water	10,276	6.0
	Total	172,160	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tomatoes	Sugar beets
	Bu	Bu	Bu	Ton	Ton	Ton
Ag. Algansee						
Bo. Bono	125	42	45	4.2	---	---
ChB. Castalia						
Co. Colwood	140	50	58	5.5	30	26
DeA. Del Rey	110	38	46	4.5	20	16
DuB. Dunbridge	85	25	36	4.0	---	---
Gn. Genesee	135	42	45	5.0	---	---
Go. Genesee Variant	90	26	36	3.5	---	---
Gr. Glendora						
HaA. Haskins	110	40	46	4.5	20	15
Hy. Hoytville	130	45	52	5.0	26	21
KfA. Kibbie	120	42	60	5.0	26	22
Lc. Latty	110	39	42	4.0	18	16
Lf. Lenawee	135	47	52	5.0	26	21
Mh. Millsdale	106	40	50	4.8	---	---
MtB. Milton	90	34	38	4.0	---	---
NpA. Nappanee	90	32	37	3.8	16	12
OaB. Oakville						
Pt*. Pits						
RaB. Rawson	105	38	48	4.2	18	12
RmA. Rimer	100	35	35	4.0	18	12

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Corn	Soybeans	Winter wheat	Grass-legume hay	Tomatoes	Sugar beets
	Bu	Bu	Bu	Ton	Ton	Ton
SbC2----------------------- St. Clair	60	18	35	3.5	---	---
Sh------------------------- Shoals	115	40	40	4.5	---	---
To------------------------- Toledo	120	37	40	4.5	22	18
Tp------------------------- Toledo	90	32	---	3.0	---	---
Ud*. Udorthents						
Wa------------------------- Wabasha	106	39	40	4.0	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	---	---	---	---
II	37,812	3,022	34,790	---
III	101,088	2,946	97,788	354
IV	12,396	---	12,058	338
V	328	---	328	---
VI	5,173	---	---	5,173
VII	---	---	---	---
VIII	---	---	---	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Ag------------------ Algansee	3s	Slight	Slight	Moderate	Slight	Quaking aspen--------	55	American sycamore, eastern cottonwood, red pine, green ash, eastern white pine.
						Silver maple---------	76	
						Pin oak--------------	80	
						American sycamore----	80	
						Red maple------------	51	
						Eastern cottonwood---	90	
Bo------------------ Bono	3w	Slight	Severe	Severe	Severe	Pin oak--------------	80	Red maple, eastern cottonwood, American sycamore, green ash, pin oak, swamp white oak.
						Swamp white oak------	---	
						Green ash------------	---	
						Red maple------------	---	
						Eastern cottonwood---	---	
						Black cherry---------	---	
ChB----------------- Castalia	5f	Slight	Moderate	Moderate	Slight	Northern red oak-----	50	Yellow-poplar, green ash, red pine, red maple, eastern white pine.
						White oak------------	---	
						Black oak------------	---	
						Black cherry---------	---	
						Yellow-poplar--------	---	
Co------------------ Colwood	2w	Slight	Severe	Severe	Severe	Pin oak--------------	90	Red maple, green ash, American sycamore, eastern cottonwood, pin oak, swamp white oak.
						Swamp white oak------	90	
						Red maple------------	---	
						White ash------------	---	
DeA----------------- Del Rey	3c	Slight	Slight	Severe	Severe	White oak------------	70	White oak, northern red oak, green ash, red maple.
						Northern red oak-----	70	
						Green ash------------	---	
DuB----------------- Dunbridge	3o	Slight	Slight	Slight	Slight	White oak------------	70	Eastern white pine, yellow-poplar, black walnut, white ash, red pine, white oak.
						Northern red oak-----	75	
						White ash------------	---	
						Black walnut---------	---	
						Black cherry---------	---	
						Sugar maple----------	---	
						Yellow-poplar--------	---	
Gn------------------ Genesee	1o	Slight	Slight	Slight	Slight	Yellow-poplar--------	100	Eastern white pine, black walnut, yellow-poplar, white ash, white oak, red pine.
						Black walnut---------	---	
						Northern red oak-----	---	
						White oak------------	---	
						White ash------------	---	
Go------------------ Genesee Variant	3o	Slight	Slight	Slight	Slight	Northern red oak-----	70	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, white oak.
						White oak------------	---	
						Black walnut---------	---	
						Black cherry---------	---	
						Sugar maple----------	---	
						White ash------------	---	
						Yellow-poplar--------	---	
Gr------------------ Glendora	5w	Slight	Severe	Moderate	Severe	Red maple------------	40	Eastern cottonwood, red maple, green ash, American sycamore.
						Quaking aspen--------	45	
						Silver maple---------	65	
						Swamp white oak------	---	
						Black ash------------	---	
						Pin oak--------------	---	
						Eastern cottonwood---	---	
HaA----------------- Haskins	2o	Slight	Slight	Slight	Slight	White oak------------	75	White ash, eastern white pine, yellow-poplar, black walnut, red pine, northern red oak, white oak.
						Northern red oak-----	80	
						Pin oak--------------	90	
						Black walnut---------	---	
						Black cherry---------	---	
						Sugar maple----------	---	
						White ash------------	---	
						Yellow-poplar--------	---	

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
Hy Hoytville	3w	Slight	Severe	Severe	Moderate	Northern red oak Pin oak White ash Green ash Black cherry Eastern cottonwood Red maple	72 76 77 --- --- --- ---	Red maple, green ash, American sycamore, eastern cottonwood, pin oak, swamp white oak.
KfA Kibbie	2o	Slight	Slight	Slight	Slight	Pin oak Northern red oak White ash Eastern cottonwood	90 --- --- ---	Eastern white pine, yellow-poplar, white ash, northern red oak, red pine, white oak.
Lc Latty	3w	Slight	Severe	Severe	Severe	Swamp white oak Pin oak Red maple Green ash Black cherry Eastern cottonwood	70 70 --- --- --- ---	Green ash, eastern cottonwood, red maple, pin oak, American sycamore, swamp white oak.
Lf Lenawee	2w	Slight	Severe	Severe	Moderate	Pin oak Red maple Green ash Black cherry Swamp white oak Eastern cottonwood	86 --- --- --- --- ---	American sycamore, eastern cottonwood, red maple, green ash, pin oak, swamp white oak.
Mh Millsdale	2w	Slight	Severe	Severe	Severe	Pin oak Red maple Eastern cottonwood Black cherry Green ash Swamp white oak	86 --- --- --- --- ---	Red maple, American sycamore, eastern cottonwood, pin oak, green ash, swamp white oak.
MtB Milton	2o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Black walnut Black cherry White oak White ash Sugar maple	80 95 --- --- --- --- ---	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, northern red oak, white oak.
NpA Nappanee	3c	Slight	Moderate	Severe	Severe	White oak Pin oak American sycamore	75 85 ---	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
OaB Oakville	3s	Slight	Slight	Severe	Slight	White oak Red pine Eastern white pine	70 78 85	Eastern white pine, red pine, green ash.
RaB Rawson	2o	Slight	Slight	Slight	Slight	White oak Northern red oak Black cherry Sugar maple White ash Yellow-poplar	75 80 --- --- --- ---	Eastern white pine, yellow-poplar, white ash, red pine, white oak.
RmA Rimer	2s	Slight	Slight	Moderate	Slight	Northern red oak White oak Red maple Bur oak Quaking aspen Green ash Slippery elm	80 75 --- --- --- --- ---	Red pine, green ash, eastern white pine.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
SbC2: St. Clair	3c	Slight	Slight	Severe	Severe	Northern red oak	66	Eastern white pine, yellow-poplar, pin oak, Austrian pine, green ash, red maple.
						White oak	62	
						White ash	---	
						Sugar maple	---	
Sh: Shoals	2o	Slight	Slight	Slight	Slight	Pin oak	90	Yellow-poplar, pin oak, eastern white pine, white ash, red pine, white oak.
						Yellow-poplar	90	
						Eastern cottonwood	---	
						White ash	---	
To: Toledo	3w	Slight	Severe	Severe	Severe	Pin oak	80	Pin oak, eastern cottonwood, American sycamore, red maple, eastern cottonwood, green ash, swamp white oak.
						Swamp white oak	80	
						Red maple	---	
						Green ash	---	
						Eastern cottonwood	---	
Wa: Wabasha	3w	Slight	Severe	Severe	Severe	Pin oak	80	Red maple, green ash, American sycamore, eastern cottonwood, pin oak, swamp white oak.
						Green ash	---	
						Red maple	---	
						Black cherry	---	
						Swamp white oak	---	
						Eastern cottonwood	---	

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ag: Algansee	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
Bo: Bono	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine, Norway spruce.	Pin oak.
ChB. Castalia					
Co: Colwood	---	American cranberrybush, silky dogwood, Amur honeysuckle, Amur privet.	Northern white-cedar, Washington hawthorn, white fir, blue spruce, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
DeA: Del Rey	---	Tatarian honeysuckle, eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood, Amur privet.	Green ash, osage-orange, Austrian pine.	Eastern white pine, pin oak.	---
DuB: Dunbridge	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
Gn: Genesee	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
Go: Genesee Variant	---	Tatarian honeysuckle, Siberian peashrub.	Green ash, osageorange, eastern redcedar, northern white-cedar, white spruce, nannyberry viburnum, Washington hawthorn.	Black willow	---
Gr. Glendora					

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
HaA: Haskins	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
Hy: Hoytville	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
KfA: Kibbie	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Northern white-cedar, Austrian pine, white fir, blue spruce, Washington hawthorn.	Norway spruce	Pin oak, eastern white pine.
Lc: Latty	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Lf: Lenawee	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, northern white-cedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Mh: Millsdale	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
MtB: Milton	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
NpA: Nappanee	---	Eastern redcedar, Washington hawthorn, Amur privet, American cranberrybush, arrowwood, Amur honeysuckle, Tatarian honeysuckle.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
OaB: Oakville	Siberian peashrub	Eastern redcedar, lilac, radiant crabapple, autumn-olive, Washington hawthorn, Amur honeysuckle, Tatarian honeysuckle.	Red pine, Austrian pine, jack pine.	Eastern white pine	---
Pt*. Pits					
RaB: Rawson	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Northern white-cedar, Austrian pine, white fir, blue spruce, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
RmA: Rimer	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
SbC2: St. Clair	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Washington hawthorn, jack pine, osageorange, Russian-olive.	Honeylocust, northern catalpa.	---	---
Sh: Shoals	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Northern white-cedar, Austrian pine, white fir, blue spruce, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
To: Toledo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Tp. Toledo					
Ud*. Udorthents					
Wa: Wabasha	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Norway spruce, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ag: Algansee	Severe: flooding, wetness, too sandy.	Severe: too sandy.	Severe: too sandy, wetness.	Severe: too sandy.	Moderate: flooding, wetness.
Bo: Bono	Severe: ponding, too clayey, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.	Severe: too clayey, ponding.
ChB: Castalia	Moderate: large stones, small stones.	Moderate: large stones, small stones.	Severe: large stones, small stones.	Slight	Severe: droughty.
Co: Colwood	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
DeA: Del Rey	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
DuB: Dunbridge	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: thin layer.
Gn: Genesee	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Go: Genesee Variant	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Gr: Glendora	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
HaA: Haskins	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
Hy: Hoytville	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
KfA: Kibbie	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Lc: Latty	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
Lf: Lenawee	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Mh: Millsdale	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MtB: Milton	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight	Moderate: thin layer.
NpA: Nappanee	Severe: wetness.	Moderate: percs slowly, wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
OaB-------------------- Oakville	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
Pt*. Pits					
RaB-------------------- Rawson	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight-----------	Slight.
RmA-------------------- Rimer	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
SbC2------------------- St. Clair	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope.
Sh--------------------- Shoals	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
To, Tp----------------- Toledo	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
Ud*. Udorthents					
Wa--------------------- Wabasha	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness, flooding.	Severe: wetness, too clayey.	Severe: wetness, flooding, too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
Ag----------------- Algansee	Poor	Fair	Fair	Poor	Poor	Fair	Fair	Fair	Poor	Fair.
Bo----------------- Bono	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
ChB---------------- Castalia	Very poor.	Poor	Fair	Poor	Poor	Poor	Very poor.	Poor	Poor	Very poor.
Co----------------- Colwood	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
DeA---------------- Del Rey	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
DuB---------------- Dunbridge	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Gn----------------- Genesee	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Go----------------- Genesee Variant	Poor	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Gr----------------- Glendora	Poor	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair.
HaA---------------- Haskins	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Hy----------------- Hoytville	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
KfA---------------- Kibbie	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
Lc----------------- Latty	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
Lf----------------- Lenawee	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
Mh----------------- Millsdale	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair	Fair.
MtB---------------- Milton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
NpA---------------- Nappanee	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
OaB---------------- Oakville	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
Pt*. Pits										
RaB---------------- Rawson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RmA---------------- Rimer	Poor	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
SbC2---------------- St. Clair	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Sh------------------ Shoals	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
To------------------ Toledo	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
Tp------------------ Toledo	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Ud*. Udorthents										
Wa------------------ Wabasha	Poor	Poor	Fair	Good	Poor	Good	Good	Fair	Good	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ag-----------------Algansee	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Moderate: flooding, wetness.
Bo-----------------Bono	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.	Severe: too clayey, ponding.
ChB----------------Castalia	Severe: depth to rock, large stones.	Severe: large stones.	Severe: depth to rock, large stones.	Severe: large stones.	Severe: large stones.	Severe: droughty.
Co-----------------Colwood	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
DeA----------------Del Rey	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
DuB----------------Dunbridge	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, frost action, shrink-swell.	Moderate: thin layer.
Gn-----------------Genesee	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Go-----------------Genesee Variant	Severe: depth to rock.	Severe: flooding.	Severe: flooding, depth to rock.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
Gr-----------------Glendora	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
HaA----------------Haskins	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
Hy-----------------Hoytville	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
KfA----------------Kibbie	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
Lc-----------------Latty	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, ponding, low strength.	Severe: ponding, too clayey.
Lf-----------------Lenawee	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Mh-----------------Millsdale	Severe: depth to rock, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, depth to rock, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
MtB----------------Milton	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Moderate: thin layer.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
NpA: Nappanee	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Moderate: wetness.
OaB: Oakville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Pt*. Pits						
RaB: Rawson	Moderate: too clayey, dense layer, wetness.	Slight	Moderate: wetness, shrink-swell.	Moderate: slope.	Moderate: frost action.	Slight.
RmA: Rimer	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness, droughty.
SbC2: St. Clair	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
Sh: Shoals	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Severe: flooding.
To, Tp: Toledo	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding, too clayey.
Ud*. Udorthents						
Wa: Wabasha	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding, too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields*	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ag------------------ Algansee	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Bo------------------ Bono	Severe: percs slowly, ponding.	Slight-----------	Severe: too clayey, ponding.	Severe: ponding.	Poor: too clayey, ponding, hard to pack.
ChB----------------- Castalia	Severe: depth to rock, large stones.	Severe: seepage, depth to rock, large stones.	Severe: depth to rock, seepage, large stones.	Severe: depth to rock, seepage.	Poor: area reclaim, large stones.
Co------------------ Colwood	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding, thin layer.
DeA----------------- Del Rey	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
DuB----------------- Dunbridge	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones.
Gn------------------ Genesee	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Go------------------ Genesee Variant	Severe: flooding, depth to rock.	Severe: depth to rock, flooding.	Severe: flooding, depth to rock.	Severe: flooding, depth to rock.	Poor: area reclaim.
Gr------------------ Glendora	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
HaA----------------- Haskins	Severe: wetness, percs slowly.	Moderate: slope, seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Hy------------------ Hoytville	Severe: ponding, percs slowly.	Slight-----------	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
KfA----------------- Kibbie	Severe: wetness.	Severe: wetness.	Severe: wetness, too sandy.	Severe: wetness.	Poor: too sandy, wetness.
Lc------------------ Latty	Severe: percs slowly, ponding.	Slight-----------	Severe: too clayey, ponding.	Severe: ponding.	Poor: too clayey, ponding, hard to pack.
Lf------------------ Lenawee	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields*	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Mh------------------ Millsdale	Severe: depth to rock, ponding, percs slowly.	Severe: depth to rock, ponding.	Severe: depth to rock, ponding, too clayey.	Severe: depth to rock, ponding.	Poor: too clayey, area reclaim, hard to pack.
MtB----------------- Milton	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey.
NpA----------------- Nappanee	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
OaB----------------- Oakville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Pt**. Pits					
RaB----------------- Rawson	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
RmA----------------- Rimer	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
SbC2---------------- St. Clair	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
Sh------------------ Shoals	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
To, Tp-------------- Toledo	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Ud**. Udorthents					
Wa------------------ Wabasha	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.

* The Ottawa County Health Department has guidelines and regulations on installing septic tank absorption fields.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ag: Algansee	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Bo: Bono	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
ChB: Castalia	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones.
Co: Colwood	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
DeA: Del Rey	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
DuB: Dunbridge	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Gn: Genesee	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Go: Genesee Variant	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, large stones, thin layer.
Gr: Glendora	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
HaA: Haskins	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
Hy: Hoytville	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
KfA: Kibbie	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lc: Latty	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Lf: Lenawee	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Mh: Millsdale	Poor: low strength, area reclaim, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.
MtB: Milton	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
NpA: Nappanee	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OaB: Oakville	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Pt*. Pits				
RaB: Rawson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
RmA: Rimer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones, thin layer.
SbC2: St. Clair	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Sh: Shoals	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
To, Tp: Toledo	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ud*. Udorthents				
Wa: Wabasha	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Grassed waterways
Ag: Algansee	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, droughty.
Bo: Bono	Slight	Severe: hard to pack, ponding.	Severe: slow refill.	Percs slowly, ponding.	Ponding, slow intake, percs slowly.	Wetness, percs slowly.
ChB: Castalia	Severe: seepage.	Severe: seepage, piping, large stones.	Severe: no water.	Deep to water	Large stones, droughty, depth to rock.	Large stones, droughty, depth to rock.
Co: Colwood	Moderate: seepage.	Severe: piping, ponding.	Severe: cutbanks cave.	Ponding, frost action.	Ponding	Wetness, erodes easily.
DeA: Del Rey	Slight	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, erodes easily, percs slowly.
DuB: Dunbridge	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Depth to rock, slope.	Large stones, depth to rock.
Gn: Genesee	Moderate: seepage.	Moderate: piping.	Severe: no water.	Deep to water	Erodes easily, flooding.	Erodes easily.
Go: Genesee Variant	Moderate: seepage, depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock, erodes easily, flooding.	Erodes easily, depth to rock.
Gr: Glendora	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, droughty.
HaA: Haskins	Moderate: seepage.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, erodes easily, rooting depth.
Hy: Hoytville	Slight	Severe: ponding.	Severe: no water.	Ponding, frost action.	Ponding, percs slowly.	Wetness, rooting depth.
KfA: Kibbie	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness	Wetness, erodes easily.
Lc: Latty	Slight	Severe: hard to pack, ponding.	Severe: no water.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Wetness, percs slowly.
Lf: Lenawee	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Wetness.
Mh: Millsdale	Moderate: depth to rock.	Severe: ponding.	Severe: no water.	Depth to rock, frost action, ponding.	Ponding, depth to rock.	Wetness, depth to rock.
MtB: Milton	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock, slope, erodes easily.	Erodes easily, depth to rock.
NpA: Nappanee	Slight	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly	Wetness, percs slowly.	Wetness, erodes easily.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Grassed waterways
OaB----------------- Oakville	Severe: seepage.	Severe: piping, seepage.	Severe: no water.	Deep to water	Fast intake, droughty, soil blowing.	Droughty.
Pt*. Pits						
RaB----------------- Rawson	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly.	Percs slowly.
RmA----------------- Rimer	Severe: seepage.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action.	Wetness, droughty, fast intake.	Wetness, droughty, percs slowly.
SbC2---------------- St. Clair	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly, rooting depth.	Slope, erodes easily, rooting depth.
Sh------------------ Shoals	Moderate: seepage.	Severe: wetness, piping.	Moderate: slow refill.	Flooding, frost action.	Wetness, erodes easily, flooding.	Wetness, erodes easily.
To------------------ Toledo	Slight----------	Severe: ponding, hard to pack.	Severe: no water.	Ponding, percs slowly, frost action.	Ponding, slow intake.	Wetness, percs slowly.
Tp------------------ Toledo	Slight----------	Severe: ponding.	Severe: no water.	Ponding, percs slowly, frost action.	Ponding, slow intake, percs slowly.	Wetness, percs slowly.
Ud*. Udorthents						
Wa------------------ Wabasha	Slight----------	Severe: wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ag---------------- Algansee	0-14	Fine sand--------	SM, SP-SM	A-2-4, A-3	0	100	100	50-70	5-15	---	NP
	14-60	Stratified fine sand to loam.	SM, SP-SM	A-3, A-2-4	0	100	100	50-70	5-15	---	NP
Bo---------------- Bono	0-14	Silty clay--------	CH, CL	A-7	0	100	98-100	95-100	80-95	40-60	20-35
	14-45	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	98-100	95-100	90-100	40-66	26-44
	45-60	Clay, silty clay loam, silty clay.	CH, CL	A-7, A-6	0	100	98-100	95-100	90-100	35-60	20-40
ChB-------------- Castalia	0-7	Very stony fine sandy loam.	SM	A-2, A-1-B	10-25	65-75	50-70	30-55	15-35	<35	NP-8
	7-20	Very channery loam, extremely channery sandy loam, channery silt loam.	ML, GM, GP-GM, SP-SM	A-4, A-2, A-1	10-50	45-80	25-70	15-65	10-60	<35	NP-8
	20-27	Very channery loam, extremely flaggy loamy sand.	GM, ML, SM	A-4, A-2, A-1	30-80	50-85	40-80	30-70	15-55	<35	NP-8
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Co---------------- Colwood	0-11	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	15-35	2-12
	11-30	Loam, sandy loam, silt loam.	CL, CL-ML	A-6, A-4	0	100	100	80-100	50-90	20-40	6-20
	30-60	Stratified silty clay loam to fine sand.	SM, ML	A-2, A-4	0	100	95-100	70-100	30-80	<35	NP-10
DeA-------------- Del Rey	0-9	Silt loam--------	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	25-45	10-25
	9-45	Silty clay loam, silty clay.	CH, CL	A-7	0	95-100	95-100	90-100	85-95	40-55	20-30
	45-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-45	10-25
DuB-------------- Dunbridge	0-9	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0-5	90-100	75-100	50-85	30-55	<25	2-7
	9-34	Loam, clay loam, gravelly sandy loam.	SM, SC, ML, CL	A-2, A-4, A-6	0-20	75-95	50-95	35-90	20-75	15-35	2-18
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gn---------------- Genesee	0-7	Silt loam--------	ML, CL	A-4, A-6	0	100	100	90-100	75-90	26-40	3-15
	7-32	Silt loam, loam	ML, CL	A-4, A-6	0	100	100	90-100	75-90	26-40	3-15
	32-60	Stratified sandy loam to silt loam.	ML, CL, CL-ML	A-4, A-6	0	90-100	85-100	60-90	50-90	20-35	3-15
Go---------------- Genesee Variant	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	20-35	3-15
	8-18	Silt loam, loam	ML, CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-100	60-80	20-35	3-15
	18-30	Silty clay loam, clay loam.	CL, ML	A-6, A-7	0-20	90-100	85-100	80-95	65-90	35-45	11-20
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Gr---------------- Glendora	0-7	Loamy fine sand	SP-SM, SM	A-3, A-2, A-4, A-1	0-5	95-100	90-100	45-95	5-40	<20	NP-4
	7-60	Stratified sand to loamy fine sand.	SP, SM, SP-SM	A-3, A-2-4, A-1-B	0-5	95-100	90-100	45-85	0-35	---	NP
HaA--------------- Haskins	0-7	Loam-------------	CL-ML, CL	A-4, A-6	0	95-100	85-100	70-100	55-90	25-40	5-20
	7-34	Sandy clay loam, clay loam, gravelly sandy clay loam.	SC, CL	A-6, A-4, A-2	0	85-100	70-100	55-85	30-65	20-40	7-20
	34-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	100	85-100	80-100	70-95	35-65	15-40
Hy---------------- Hoytville	0-7	Silty clay loam	CL	A-7	0-5	100	90-100	80-100	70-100	40-50	22-30
	7-46	Clay, silty clay	CH, CL, MH	A-7	0-5	100	85-100	80-100	75-100	42-66	22-40
	46-60	Clay, silty clay loam.	CH, CL, MH	A-7	0-5	100	85-100	80-100	75-100	40-62	22-40
KfA--------------- Kibbie	0-9	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	100	75-95	40-60	18-25	2-7
	9-37	Silt loam, silty clay loam, loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	0	90-100	85-100	80-100	35-90	25-45	6-25
	37-60	Stratified silty clay loam to fine sand.	ML, SM, SC, CL	A-4, A-2	0	100	95-100	70-95	30-80	<30	NP-10
Lc---------------- Latty	0-9	Silty clay-------	CH, MH	A-7	0	100	100	90-100	85-100	50-75	20-40
	9-45	Clay, silty clay	CH	A-7	0	100	100	90-100	85-100	50-70	25-45
	45-60	Clay, silty clay	CH	A-7	0	100	100	90-100	85-100	50-70	25-45
Lf---------------- Lenawee	0-9	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	50-95	25-45	11-22
	9-49	Silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	80-95	40-55	20-30
	49-60	Silt loam, silty clay loam, clay loam.	CL, CL-ML	A-6, A-4, A-7	0	100	95-100	95-100	85-95	25-45	6-22
Mh---------------- Millsdale	0-10	Silty clay loam	CL	A-6, A-7	0	90-100	80-100	75-100	60-95	32-50	12-25
	10-29	Clay, silty clay loam, clay loam.	CH, CL	A-7	0-5	85-100	80-100	75-100	60-95	40-60	20-35
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
MtB--------------- Milton	0-6	Silt loam--------	ML, CL	A-4, A-6	0	95-100	90-100	85-100	70-95	26-36	4-12
	6-36	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7	0	95-100	80-100	75-100	70-95	32-48	12-28
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
NpA--------------- Nappanee	0-8	Silty clay loam	CL	A-7	0-5	95-100	95-100	85-100	70-95	40-50	20-25
	8-34	Silty clay, clay	CH	A-7	0-5	95-100	95-100	85-100	70-95	50-70	25-45
	34-60	Silty clay, clay, clay loam.	CL, CH	A-7	0-5	95-100	95-100	85-100	70-95	40-60	20-35
OaB--------------- Oakville	0-4	Fine sand--------	SM, SP, SP-SM	A-2, A-3	0	100	100	50-85	0-35	---	NP
	4-60	Fine sand, sand, loamy fine sand.	SM, SP, SP-SM	A-2, A-3	0	100	95-100	65-95	0-25	---	NP
Pt*. Pits											
RaB--------------- Rawson	0-10	Loam-------------	CL,CL-ML	A-4, A-6	0	90-100	80-100	65-100	50-100	25-40	4-16
	10-23	Clay loam, sandy clay loam, gravelly loam.	SC, CL	A-4, A-6, A-2-4, A-2-6	0	65-100	55-95	45-90	25-75	20-40	7-20
	23-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	90-100	85-100	85-100	75-95	35-65	15-40

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
RmA--------------- Rimer	0-14	Loamy fine sand	SM	A-2, A-4	0	100	95-100	75-85	30-45	---	NP
	14-26	Loamy fine sand, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	100	95-100	65-80	30-45	<30	NP-10
	26-37	Silty clay--------	CH, MH, CL, ML	A-7	0	100	90-100	85-100	80-100	45-70	20-35
	37-60	Stratified loam to silty clay.	CL, ML, MH, CH	A-6, A-7, A-4	0	100	90-100	80-100	65-95	25-60	5-30
SbC2-------------- St. Clair	0-7	Silty clay loam	CL	A-4, A-6	0-5	95-100	90-100	80-100	60-95	27-37	9-16
	7-23	Clay, silty clay	CH, MH	A-7	0-5	95-100	90-100	75-100	65-95	50-70	21-41
	23-60	Clay, silty clay	CH	A-7	0-5	95-100	90-100	70-100	60-95	50-60	29-34
Sh---------------- Shoals	0-10	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	20-35	6-15
	10-47	Silt loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-85	25-40	5-15
	47-60	Stratified silty clay loam to sandy loam.	ML, CL, CL-ML	A-4	0-3	90-100	85-100	60-80	50-70	<30	4-10
To---------------- Toledo	0-7	Silty clay--------	CH, MH, CL, ML	A-7	0	100	100	90-100	80-100	40-65	18-32
	7-48	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-65	18-36
	48-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	80-100	40-65	18-36
Tp---------------- Toledo	0-6	Silty clay--------	CH, MH, ML, CL	A-7	0	100	100	95-100	90-100	45-60	18-32
	6-41	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-60	18-32
	41-60	Silty clay, clay	CH, CL	A-7, A-6	0	100	100	95-100	85-100	35-60	16-32
Ud*. Udorthents											
Wa---------------- Wabasha	0-9	Silty clay--------	CL, CH	A-7	0	100	100	95-100	85-100	40-60	25-35
	9-50	Silty clay, clay	CH, CL	A-7	0	100	100	90-100	80-100	45-65	22-35
	50-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	80-100	40-65	18-35

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Ag---------------- Algansee	0-14	0-10	1.35-1.50	>20	0.05-0.07	5.6-7.3	Low----------	0.17	5	1	1-4
	14-60	0-18	1.40-1.65	>20	0.05-0.07	5.6-7.8	Low----------	0.17			
Bo---------------- Bono	0-14	40-45	1.20-1.45	0.2-2.0	0.20-0.23	6.1-7.3	High---------	0.28	5	4	4-8
	14-45	40-55	1.35-1.55	<0.2	0.10-0.14	6.1-8.4	High---------	0.28			
	45-60	35-60	1.45-1.60	<0.2	0.08-0.12	7.4-8.4	High---------	0.28			
ChB--------------- Castalia	0-7	10-18	1.20-1.35	6.0-20	0.05-0.15	7.4-8.4	Low----------	0.15	2	8	3-6
	7-20	10-18	1.30-1.40	6.0-20	0.03-0.13	7.4-8.4	Low----------	0.10			
	20-27	10-18	1.30-1.40	6.0-20	0.02-0.09	7.4-8.4	Low----------	0.10			
Co---------------- Colwood	0-11	5-26	1.15-1.60	0.6-2.0	0.20-0.24	6.1-7.8	Low----------	0.28	5	5	3-8
	11-30	18-35	1.30-1.60	0.6-2.0	0.17-0.22	6.1-8.4	Moderate-----	0.43			
	30-60	0-12	1.20-1.45	0.6-2.0	0.12-0.22	7.4-8.4	Low----------	0.43			
DeA--------------- Del Rey	0-9	15-27	1.30-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	2-3
	9-45	35-45	1.40-1.65	0.06-0.2	0.12-0.20	4.5-8.4	Moderate-----	0.43			
	45-60	25-35	1.50-1.70	0.06-0.2	0.09-0.11	7.9-8.4	Moderate-----	0.43			
DuB--------------- Dunbridge	0-9	6-12	1.35-1.50	2.0-6.0	0.16-0.18	6.1-7.8	Low----------	0.17	2	3	2-4
	9-34	18-30	1.45-1.70	2.0-6.0	0.10-0.18	6.1-7.8	Moderate-----	0.32			
	34	---	---	---	---	---	-------------	----			
Gn---------------- Genesee	0-7	18-27	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.8	Low----------	0.37	5	5	1-3
	7-32	18-27	1.30-1.50	0.6-2.0	0.17-0.22	6.1-8.4	Low----------	0.37			
	32-60	10-20	1.30-1.50	0.6-2.0	0.19-0.21	7.4-8.4	Low----------	0.37			
Go---------------- Genesee Variant	0-8	12-25	1.20-1.50	0.6-2.0	0.20-0.24	6.6-7.8	Low----------	0.37	4	5	1-3
	8-18	12-25	1.25-1.60	0.6-2.0	0.17-0.22	6.6-7.8	Low----------	0.37			
	18-30	30-40	1.25-1.60	0.6-2.0	0.13-0.18	6.6-7.8	Moderate-----	0.37			
	30	---	---	---	---	---	-------------	----			
Gr---------------- Glendora	0-7	0-15	1.35-1.50	2.0-20	0.07-0.15	5.6-7.8	Low----------	0.17	5	2	---
	7-60	0-10	1.40-1.65	6.0-20	0.05-0.11	5.6-8.4	Low----------	0.17			
HaA--------------- Haskins	0-7	12-20	1.30-1.45	0.6-2.0	0.18-0.22	5.1-7.3	Low----------	0.37	4	5	1-4
	7-34	18-35	1.45-1.70	0.6-2.0	0.12-0.16	5.1-7.3	Low----------	0.37			
	34-60	35-55	1.60-1.80	<0.2	0.08-0.12	6.1-8.4	Moderate-----	0.37			
Hy---------------- Hoytville	0-7	27-40	1.25-1.50	0.2-2.0	0.16-0.21	6.1-7.3	High---------	0.28	5	7	3-6
	7-46	40-55	1.40-1.80	0.2-0.6	0.11-0.15	6.1-7.8	High---------	0.28			
	46-60	35-50	1.40-1.85	0.06-0.2	0.06-0.12	7.4-8.4	High---------	0.28			
KfA--------------- Kibbie	0-9	2-20	1.40-1.65	0.6-2.0	0.16-0.20	5.6-7.3	Low----------	0.20	5	3	2-3
	9-37	18-35	1.40-1.65	0.6-2.0	0.17-0.22	5.6-7.3	Low----------	0.43			
	37-60	2-18	1.40-1.70	0.6-2.0	0.12-0.22	7.4-8.4	Low----------	0.43			
Lc---------------- Latty	0-9	40-55	1.30-1.50	0.06-0.2	0.11-0.14	6.1-7.8	High---------	0.28	5	4	3-5
	9-45	45-60	1.35-1.65	0.06-0.2	0.09-0.13	6.1-7.8	High---------	0.28			
	45-60	45-60	1.45-1.60	<0.06	0.08-0.12	7.4-8.4	High---------	0.28			
Lf---------------- Lenawee	0-9	27-35	1.40-1.55	0.6-2.0	0.14-0.22	5.6-7.8	Moderate-----	0.28	4	7	3-5
	9-49	35-45	1.40-1.70	0.2-0.6	0.14-0.20	6.1-7.8	Moderate-----	0.28			
	49-60	18-40	1.50-1.70	0.2-0.6	0.16-0.22	7.4-8.4	Low----------	0.28			
Mh---------------- Millsdale	0-10	27-32	1.30-1.50	0.6-2.0	0.19-0.22	6.1-7.3	Moderate-----	0.32	4	6	4-7
	10-29	35-45	1.40-1.70	0.2-0.6	0.12-0.16	6.1-8.4	High---------	0.32			
	29	---	---	---	---	---	-------------	----			
MtB--------------- Milton	0-6	14-27	1.30-1.50	0.6-2.0	0.18-0.23	5.1-7.3	Low----------	0.37	4	6	1-3
	6-36	35-50	1.45-1.70	0.2-0.6	0.12-0.18	4.5-7.8	Moderate-----	0.37			
	36	---	---	---	---	---	-------------	----			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
NpA: Nappanee	0-8	32-40	1.30-1.50	0.2-0.6	0.18-0.22	5.1-7.3	Moderate	0.43	3	7	1-3
	8-34	45-60	1.40-1.80	0.06-0.2	0.08-0.14	5.1-7.8	Moderate	0.32			
	34-60	35-50	1.60-1.85	0.06-0.2	0.06-0.12	7.4-8.4	Moderate	0.32			
OaB: Oakville	0-4	0-10	1.30-1.55	6.0-20	0.07-0.09	5.6-7.3	Low	0.15	5	1	.5-2
	4-60	0-10	1.30-1.65	6.0-20	0.06-0.10	5.6-7.3	Low	0.15			
Pt*. Pits											
RaB: Rawson	0-10	12-20	1.35-1.50	0.6-2.0	0.18-0.22	4.5-7.3	Low	0.32	4	5	1-3
	10-23	18-35	1.50-1.70	0.6-2.0	0.12-0.16	5.1-7.8	Low	0.32			
	23-60	35-55	1.60-1.85	<0.2	0.08-0.12	6.6-8.4	Moderate	0.32			
RmA: Rimer	0-14	5-15	1.40-1.60	6.0-20.0	0.10-0.14	5.1-7.3	Low	0.17	4	2	1-3
	14-26	5-18	1.40-1.60	6.0-20.0	0.08-0.14	5.1-7.3	Low	0.17			
	26-37	40-50	1.40-1.70	0.06-0.2	0.11-0.13	6.1-7.8	High	0.32			
	37-60	20-45	1.40-1.70	0.06-0.2	0.10-0.18	7.4-8.4	Moderate	0.32			
SbC2: St. Clair	0-7	27-40	1.50-1.60	0.2-2.0	0.17-0.23	5.6-7.3	Moderate	0.37	2	7	1-3
	7-23	50-60	1.35-1.70	<0.2	0.10-0.12	5.6-8.4	High	0.37			
	23-60	40-55	1.60-1.75	<0.2	0.09-0.11	7.4-8.4	High	0.37			
Sh: Shoals	0-10	18-27	1.30-1.50	0.6-2.0	0.22-0.24	6.1-7.8	Low	0.37	5	5	2-5
	10-47	18-32	1.35-1.55	0.6-2.0	0.17-0.22	6.1-7.8	Low	0.37			
	47-60	12-25	1.35-1.60	0.6-2.0	0.12-0.21	6.6-7.8	Low	0.37			
To: Toledo	0-7	40-55	1.45-1.65	0.2-0.6	0.12-0.14	6.1-7.3	High	0.28	5	4	3-6
	7-48	40-60	1.40-1.70	0.06-0.2	0.09-0.13	6.1-7.8	High	0.28			
	48-60	35-60	1.45-1.75	0.06-0.2	0.08-0.12	7.4-8.4	High	0.28			
Tp: Toledo	0-6	40-55	1.45-1.65	0.2-0.6	0.12-0.14	6.1-7.3	High	0.28	5	4	4-8
	6-41	40-60	1.40-1.70	0.06-0.2	0.10-0.13	6.1-7.8	High	0.28			
	41-60	40-60	1.45-1.75	0.06-0.2	0.08-0.12	7.4-8.4	High	0.28			
Ud*. Udorthents											
Wa: Wabasha	0-9	40-45	1.35-1.55	0.2-0.6	0.14-0.18	6.1-7.8	High	0.32	5	4	3-6
	9-50	40-55	1.35-1.65	0.06-0.2	0.12-0.16	6.1-7.8	High	0.32			
	50-60	35-55	1.50-1.65	0.06-0.2	0.12-0.17	6.1-8.4	High	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ag----------------- Algansee	B	Occasional	Long-------	Nov-May	1.0-2.0	Apparent	Nov-May	>60	---	Moderate	Low--------	Low.
Bo----------------- Bono	B/D	None----------	---	---	+1-1.0	Apparent	Dec-May	>60	---	Moderate	High------	Low.
ChB---------------- Castalia	C	None----------	---	---	>6.0	---	---	20-40	Hard	Moderate	Low--------	Low.
Co----------------- Colwood	B/D	None----------	---	---	+1-1.0	Apparent	Oct-May	>60	---	High------	High------	Low.
DeA---------------- Del Rey	C	None----------	---	---	1.0-3.0	Apparent	Jan-May	>60	---	High------	High------	Moderate.
DuB---------------- Dunbridge	B	None----------	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	Low.
Gn----------------- Genesee	B	Frequent-----	Brief------	Oct-Jun	>6.0	---	---	>60	---	Moderate	Low--------	Low.
Go----------------- Genesee Variant	B	Frequent-----	Brief------	Jan-May	>6.0	---	---	20-40	Hard	Moderate	Low--------	Low.
Gr----------------- Glendora	A/D	Frequent-----	Long-------	Jan-Dec	0-1.0	Apparent	Nov-Jun	>60	---	Moderate	High------	Moderate.
HaA---------------- Haskins	C	None----------	---	---	1.0-2.5	Perched	Jan-Apr	>60	---	High------	High------	Moderate.
Hy----------------- Hoytville	D	None----------	---	---	+1-1.0	Perched	Jan-Apr	>60	---	High------	High------	Low.
KfA---------------- Kibbie	B	None----------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	High------	Low--------	High.
Lc----------------- Latty	D	None----------	---	---	+.5-1.0	Perched	Jan-Apr	>60	---	Moderate	High------	Low.
Lf----------------- Lenawee	B/D	None----------	---	---	+1-1.0	Apparent	Nov-May	>60	---	High------	High------	Low.
Mh----------------- Millsdale	B/D	None----------	---	---	+1-1.0	Perched	Jan-Apr	20-40	Hard	High------	High------	Low.
MtB---------------- Milton	C	None----------	---	---	>6.0	---	---	20-40	Hard	Moderate	High------	Moderate.
NpA---------------- Nappanee	D	None----------	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High------	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
OaB: Oakville	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
Pt*. Pits												
RaB: Rawson	B	None	---	---	2.5-4.0	Perched	Jan-Apr	>60	---	Moderate	High	High.
RmA: Rimer	C	None	---	---	1.0-2.5	Perched	Jan-Apr	>60	---	High	High	Moderate.
SbC2: St. Clair	D	None	---	---	2.0-3.0	Perched	Mar-May	>60	---	Moderate	High	Moderate.
Sh: Shoals	C	Frequent	Brief	Oct-Jun	1.0-3.0	Apparent	Jan-Apr	>60	---	High	High	Low.
To: Toledo	D	None	---	---	+1-1.0	Perched	Jan-Apr	>60	---	High	High	Low.
Tp: Toledo	D	None	---	---	+3-1.0	Perched	Sep-May	>60	---	High	High	Low.
Ud*. Udorthents												
Wa: Wabasha	D	Frequent	Long	Jan-May	0-1.0	Apparent	Dec-Jun	>60	---	High	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
*Algansee	Mixed, mesic Aquic Udipsamments
*Bono	Fine, illitic, mesic Typic Haplaquolls
Castalia	Loamy-skeletal, carbonatic, mesic Eutochreptic Rendolls
*Colwood	Fine-loamy, mixed, mesic Typic Haplaquolls
Del Rey	Fine, illitic, mesic Aeric Ochraqualfs
Dunbridge	Fine-loamy, mixed, mesic Mollic Hapludalfs
Genesee	Fine-loamy, mixed, nonacid, mesic Typic Udifluvents
Genesee Variant	Fine-loamy, mixed, nonacid, mesic Typic Udifluvents
Glendora	Mixed, mesic Mollic Psammaquents
Haskins	Fine-loamy, mixed, mesic Aeric Ochraqualfs
Hoytville	Fine, illitic, mesic Mollic Ochraqualfs
Kibbie	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Latty	Fine, illitic, nonacid, mesic Typic Haplaquepts
Lenawee	Fine, mixed, nonacid, mesic Mollic Haplaquepts
*Millsdale	Fine, mixed, mesic Typic Argiaquolls
Milton	Fine, mixed, mesic Typic Hapludalfs
Nappanee	Fine, illitic, mesic Aeric Ochraqualfs
Oakville	Mixed, mesic Typic Udipsamments
*Rawson	Fine-loamy, mixed, mesic Typic Hapludalfs
*Rimer	Loamy, mixed, mesic Aquic Arenic Hapludalfs
St. Clair	Fine, illitic, mesic Typic Hapludalfs
Shoals	Fine-loamy, mixed, nonacid, mesic Aeric Fluvaquents
Toledo	Fine, illitic, nonacid, mesic Mollic Haplaquepts
Udorthents	Clayey and loamy, mixed, nonacid, mesic Udorthents
*Wabasha	Fine, illitic, nonacid, mesic Mollic Fluvaquents

* The soil is a taxadjunct to the series. See text for description of those characteristics of the soil that are outside the range of the series.

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